Engineering Library

Engineering News-Record

A Consolidation of Engineering News and Engineering Record
McGRAW-HILL COMPANY, INC.

March 28, 1918

This American Railroad Regiment, here seen parading in London, and later baptized with fire on the British Front, symbolizes the engineering genius of our country, which is today marshalling every resource of transportation and production to hasten the triumph of democracy.

Now again we are called upon, in the campaign just opening for the Third Liberty Loan, to back our engineering genius with our money—and to the last dollar. Its triumph shall not be delayed because any of us fails to give his utmost!

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ENGINEERING NEWS-RECORD

A WEEKLY JOURNAL
DEVOTED TO CIVIL ENGINEERING
AND CONTRACTING

E. J. MEHREN, *Editor*

CHARLES WHITING BAKER, *Consulting Editor*

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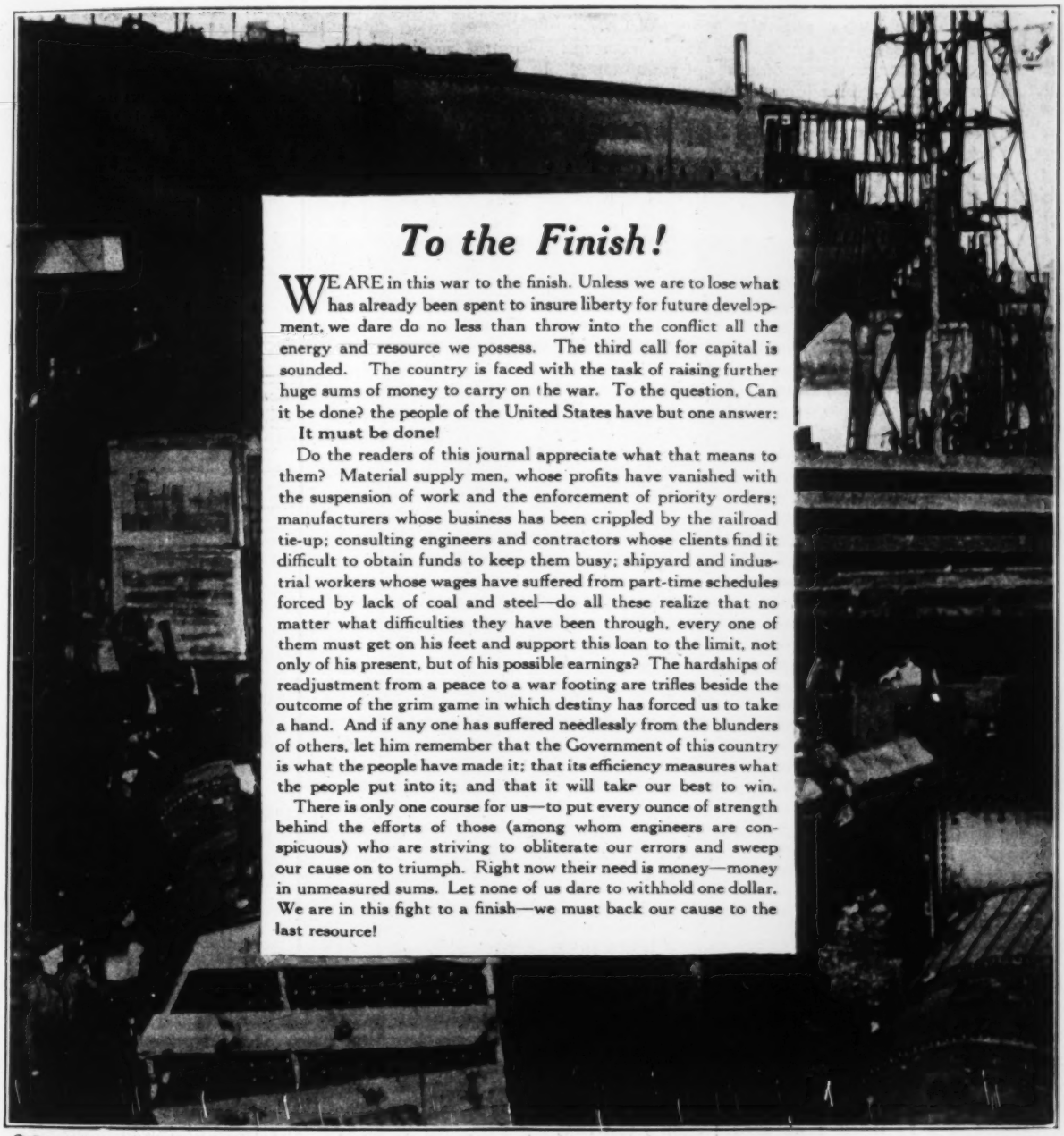

To the Finish!

WE ARE in this war to the finish. Unless we are to lose what has already been spent to insure liberty for future development, we dare do no less than throw into the conflict all the energy and resource we possess. The third call for capital is sounded. The country is faced with the task of raising further huge sums of money to carry on the war. To the question, Can it be done? the people of the United States have but one answer:

It must be done!

Do the readers of this journal appreciate what that means to them? Material supply men, whose profits have vanished with the suspension of work and the enforcement of priority orders; manufacturers whose business has been crippled by the railroad tie-up; consulting engineers and contractors whose clients find it difficult to obtain funds to keep them busy; shipyard and industrial workers whose wages have suffered from part-time schedules forced by lack of coal and steel—do all these realize that no matter what difficulties they have been through, every one of them must get on his feet and support this loan to the limit, not only of his present, but of his possible earnings? The hardships of readjustment from a peace to a war footing are trifles beside the outcome of the grim game in which destiny has forced us to take a hand. And if any one has suffered needlessly from the blunders of others, let him remember that the Government of this country is what the people have made it; that its efficiency measures what the people put into it; and that it will take our best to win.

There is only one course for us—to put every ounce of strength behind the efforts of those (among whom engineers are conspicuous) who are striving to obliterate our errors and sweep our cause on to triumph. Right now their need is money—money in unmeasured sums. Let none of us dare to withhold one dollar. We are in this fight to a finish—we must back our cause to the last resource!

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To keep up a ceaseless flow of materials, such as these locomotives being unloaded at a French port, we must nave money

Production and Victory

THIS is a war of industries — Germany's against those of the Allies. To whip Germany in arms, we must whip her first in production—production on the farms, in the factories and in our transportation system. Maximum production cannot be secured unless the workers put forth their best efforts. They will not do that until they are assured that no one will profit unduly by their efforts, and until in their hearts they believe that they can win the war. That is why the labor problem is vital today, why the *Engineering News-Record* and the other McGraw-Hill papers are giving it so much attention. Without the full effort of the worker we cannot get tremendous production; without tremendous production we cannot win the war.

First, we need a greater production of transportation. That is to be secured not alone from new ships, new trackage, new terminals, but by using existing facilities to the utmost. We need better highways, and greater use of those we have. We need more fuel (more developed water power), more food, more of all those things needed for sustaining an army.

Greater production is the demand all along the line. When we have more of these things than Germany, more food for fighter and civilian, more shells to shoot and adequate carriage facilities for bringing the food and munitions and fighters into effective action, the fall of Prussianism will not be long delayed.

The supreme problem, then, is to secure tremendously increased production. We are not now getting it. Various difficulties have stood in the way. There has been government inefficiency, like the Shipping Board's fight of last spring. But the greatest deterrent is profiteering by the worker through restriction of output. This will continue as long as he thinks his employers are profiteering, and until he is educated to the life and death character of this struggle and the part which he can play therein.

In England, apparently, they have suceeded fairly well. We know that there are still differences between capital and labor, but labor has taken off its coat, thrown down its restrictions and is after maximum production. First, though, the Government assured the men that, except for a relatively small incentive to the capitalist, the nation alone should profit from the unrestrained application of the worker. Eighty per cent. of profits above the pre-war normal goes to the public treasury.

We must come to some similar understanding in this country. It is the business of the labor policy board, now meeting in Washington, to find the way out. That is why their findings are so eagerly awaited.

Their report must be right. It must give the worker assurance that his maximum efforts will not result in undue private gain. That assurance being given, he needs to be convinced of his part in the great struggle. When those two ideas are grasped all that remains is engineering — a clear comprehension of the end in view and a scientific analysis of all the factors. The banker, the accountant, become the servant of the engineer — for the engineer is the master producer.

Better Superstructure Demands Better Foundation

IMPROVEMENT of railway track is shown in a new aspect by the experimental track studies reported in *Engineering News-Record* two weeks ago. Efficiency and economy, it appears from these studies, call for a certain relation between substructure and superstructure in track just as in bridges. In an indefinite way this truth has been understood by track men for a long time. But those who believed that it does not pay to put heavy rail on light roadbed had no proof to back their belief. Now, however, the measurements of bending stresses in rails furnish the proof. When light rail is replaced by heavy rail on the same roadbed, the gain in load-carrying power is far less than should be obtained through the increased girder strength of the rail. The heavy rail, by distributing each wheel load over a greater length of track, is subjected to higher bending moments, or in other words is more severely taxed than the lighter rail. It is true that the stresses in the heavy rail are lower than those in the light rail, so that it makes better track even without improvement of the roadbed; but the full advantage of the added metal is not secured. Efficiency requires that the track substructure be made more substantial at the same time that heavier rail is put down. Study of the test data in connection with track costs should enable the best relation of the two parts to be expressed in specific figures. This knowledge will be important in the campaign of railway improvement that lies ahead.

Civilians Do Not Head Cantonment Division

THROUGH some misinterpretation of a dispatch sent out from Washington a number of daily papers and at least one technical journal have assumed that the Construction Division of the Army, formerly the Cantonment Division of the Quartermaster Corps, is now under the direction of a committee of civilians, made up mainly of representatives of technical societies. Such is not the case. As noted in *Engineering News-Record* of last week, p. 550, such a committee passed on the form of contract in use in the Cantonment Division, but that ended its functions. The division is a branch of the War Department, reporting direct to the Chief of Staff, and is headed by Col. R. C. Marshall, Jr., U. S. A. Its directing officers are all commissioned in the army.

General Wood Urges Haste

SPEAKING before the Senate Committee on Military Affairs on Tuesday last, General Leonard Wood intimated that the Allies are disappointed with our war performance. Fewer men have been sent than were expected. We have failed to equip them with artillery or aircraft. Eminent military authority that the General is, he naturally looks at the military side of the matter—a great army of five millions with ample equipment and supplies—and places ships second in importance in our offensive scheme. The soldier

thinks only of charges and battles—the "business" man who has made his fortune in speculation only of trading and raising loans—and the country waits for the engineer to solve the riddle of how those soldiers will be withdrawn without stifling production, of how they will be carried across the water and maintained on the front without stinting our Allies of the supplies we must give them. How much longer must we wait until the great problem is analyzed, not from the military, not from the "business," but from the engineering standpoint? It is well that General Wood should bear in on us our shortcomings—onesided as the remedy he proposes may appear. The desperate need evidenced by the death-grapple being staged in the valley of the Somme may well shake our hearts with a fear of the consequences should our help come too late. Each of these shocks emphasizes the truth that we shall get nowhere until we have an engineering conception of our whole problem—and based on that a dynamic, constructive engineering plan for meeting that problem.

The Subway Contract Tangle and the Gold Dollar

A GREAT many contractors, caught by rising prices on long-term construction contracts, have suffered severe losses. In a large number of cases owners for whom these contractors were executing work have felt the loss, and disorganization resulting in every such case has affected by just so much the economic strength of the country. The seriousness of the difficulty is emphasized by the fact, noted last week, that one state is considering legislation to relieve contractors sufficiently to permit the completion of large public works, among them the New York subway system, suspension of which is threatened for an indefinite period.

This situation should set contractors and engineers thinking along the lines laid down by Prof. Irving Fisher in a talk recently delivered before the Cosmos Club in Washington. Professor Fisher made the point that the wide price fluctuations we have experienced are due to gold inflation. All the difficulty, therefore, which can be traced to price variations might be avoided if some way were found to stabilize the price—in terms of other commodities rather than in terms of currency—of gold. At present the United States is obliged to pay one dollar for every 18.6 ounces of gold that is offered on the market. This, while it makes the value of 18.6 ounces of gold stable at one dollar in United States currency, does not prevent fluctuations in the real value of gold. On the contrary, it makes the United States dollar vary in value with the fluctuations in the real value of gold. This is expressed in popular parlance by saying that prices have gone up or down. Of course, values in general fluctuate irrespective of prices in terms of money. These fluctuations, however, are in proportion to the ratio of production to population, and cannot under any circumstances result in such wide price ranges as have been witnessed of late.

With the great oversupply of gold which has poured into the country since the outbreak of the European war, our currency, based on gold, has depreciated as gold became more common and as its real relative value went down. The effect was just as though a similar quantity of fiat currency had been issued, as occurred during the Civil War. Since gold had become twice as common, and consequently twice as cheap, in comparison with ordinary commodities, the supply of which remained normal, prices in terms of United States currency, based on gold, doubled. Men with a fixed amount of United States currency promised them, for which they had to deliver certain things that they must purchase with that money, were heavy losers; while men who were in the position of having to pay out money and receive goods in the future became better off the higher prices rose. Contractors were caught in the first situation. They had agreed to perform work for money, and the cost to them of the work they were delivering continued to rise, while the value of the money they were receiving for it continued to decrease.

All this, said Professor Fisher, is unnecessary. The commodity index, which measures the price changes of other things in terms of gold currency, and with which engineers are familiar, can be used as a thermometer of the fluctuations that take place in the real price of gold, and the weight of gold in a dollar can be varied inversely according to the reading of the index so that the value of the United States dollar in terms of a long list of commodities represented in the index will remain stationary. Whether this concrete proposal for making the dollar stable in terms of a wide range of commodities may be questioned on grounds of practicality, it should start those who have suffered from the present gold inflation to thinking whether there may be found some better basis of measuring the standard value of a dollar than merely making it equivalent to an arbitrary weight of a precious metal which it has been proved may fluctuate widely in value, with disastrous effect on industry.

Essentials to Beginning a City Plan

WHAT ARE the essentials to the beginning of a city plan? The question assumes a city which, like Topsy, has "just growed," but which in its future growth is to be shaped to a well-considered plan.

The first essential to beginning a city plan is some branch of the Government vested with city planning powers. A hundred or more American cities have established city-planning commissions. It is true that but few of these commissions have adequate powers, but the mere appointment of a permanent city-planning commission, even if it is to have only advisory powers, is a great gain. The good that may come from merely advisory commissions is shown by experience in Massachusetts. A few years ago, the legislature passed an act providing for city-planning commissions in all cities of the state and also in all towns of more than 10,000 inhabitants. A few lines from the third annual report of the Springfield commission indicate clearly the second step in preparing for a city plan:

"During the past year the preparatory work essential to the actual beginning of a city plan has been practically completed, with the exception of the city's

topographical map. In other words, the commission, since beginning its work, has completed the compilation of all statistics which may be of assistance in determining questions which will arise and has completed a comprehensive set of diagrams, maps, charts, and drawings designed to assist the work through graphic presentation of useful and necessary information. Little is now needed, in fact, aside from the topographical map, to furnish skilled advisers with all the material which they will need in the actual preparation of a comprehensive city plan."

Charts and maps mentioned in the report which may be considered as suggestive, rather than a complete list for any other city, are: (1 Radial, (2) main and (3) circumferential thoroughfares; (4) sewerage, (5) trolley and (6) water systems; (7) areas served by trolley; (8) parks and playgrounds; (9) schoolhouses; (10) developed and undeveloped sections; (11) assessed valuations; (12) Springfield streets.

In Springfield the topographical map and the other maps and charts are being provided by the Department of Streets and Engineering. This commendable example of coöperation shows how a city planning commission can sometimes accomplish its ends at small outlay and without duplicating work belonging to another city department.

The ideal city planning commission would have larger powers and be a more organic part of the city government than are the Massachusetts commissions, but these commissions and the Springfield report serve to illustrate the prime essentials to the beginning of a city plan: (1) A recognized branch of the city government whose business it is to consider city planning; (2) a topographic map of the city; (3) maps, charts, and statistics showing the status of the various elements of the city plan, in order that they may be brought into a more harmonious whole and so made to meet the individual, social, and industrial needs of all the citizens.

Railway Owners Fairly Dealt With

WHEN the President, under the authority of a broad statute relating to powers for the conduct of the war, took possession of the railways of the United States last December, predictions were generally heard that this was the first step toward ultimate Government ownership and that the roads would never be returned to the companies. In the act just passed by Congress after a brisk controversy between the advocates and the opponents of Government ownership, the outstanding feature is the careful provisions respecting compensation to the owners of the railways and provision for return of the railways to the companies within a fixed limit of time. The purport and spirit of the law is, in fact, summed up in the final section, which reads:

"This act is expressly declared to be emergency legislation enacted to meet conditions growing out of war and nothing herein contained is to be construed as expressing or prejudicing the future policy of the Federal Government covering the ownership, control or regulation of carriers."

Without doubt, the battle over Government ownership vs. private ownership will have sooner or later to be fought out in Congress and probably at the polls, but for the present Congress has determined that the taking of the railways by the Government shall be because of war's emergency only and has provided the machinery for compensating the owners and ultimate return to them of the lines.

The major part of the act is in fact taken up with detail provisions for this machinery. When we turn to the act to find an outline of the policy and methods by which the executive is to carry on this vast business, we find practically unlimited authority bestowed on the President. The act says that "The President may execute any of the powers herein and heretofore granted him through such agencies as he may determine." The sole limitations are the final return of the roads to their owners within not more than 21 months after the close of the war, an upper limit of compensation to a rate equal to the average net earnings for the three years ending June 30, 1917, and a possible final review by the Interstate Commerce Commission of any rates that may be fixed.

In addition, a revolving fund of half a billion dollars is created from which the Administration can provide for the necessary capital requirements of the railways during the period of Government control, not only for building extensions, terminals, equipment, etc., but for financing maturing obligations of companies, where they are unable to raise the money themselves.

No criticism can fairly be made of Congress because of the breadth of authority thus granted. If the Governmen contract is to be successful—and no one can possibly desire anything else—its policy and methods can be far better determined by those in authority as the necessity arises, though they could be fixed in advance by Congress.

That there will be some advance in railway rates, more or less general, is to be expected. The implications of the section giving authority to fix rates is that the properties are to earn enough to pay all operating expenses, taxes and compensation to the owners. Whatever saving may be made in cutting off expenses which have been incurred hitherto by carrying on a competitive business will doubtless be far more than balanced by increases of wages to meet increased living expenses and competitive conditions in the labor market, and by increasing cost of materials.

While rates are pretty certain to be increased so that the operation of the roads will not involve any burden on the treasury, an increase sufficient to make the roads large revenue producers to the Government is most unlikely. Such a measure would be most unpopular, and the taxes already laid on railway revenues by the Federal Government provided at least as large a return as is drawn from other lines of industry.

On the whole the large experiment of Government railway operation has started out under conditions more favorable than could possibly exist at any other time. Chiefest of all is the fact that the railway workers, from the president down to the day laborers, are filled with the patriotic desire to aid their country at a time of crisis; and will do their part to make the operation of the railways by the Federal Government a success.

Timber-Arch Truss Roof with Steel Gusset-Plates

Three-Hinged Arch Garage Roof Has Timber Tension Members—Bolted Connections with Steel Plates—Tie-Rods Partly Anchored by Floor Concrete

By H. W. Sheley
Consulting Engineer, Salt Lake City, Utah

IN FRAMING a roof of 82-ft. span for a garage in Salt Lake City, three-hinged arch trusses built of timber were adopted. The tension members as well as the chords and web struts are of wood; the joints are bolted connections with steel gusset plates, making the design in many respects similar to that of a steel truss. The thrust of the arches is taken by tie-rods in the floor. These are of unusual character, being plain round rods bent at the ends, the successive lengths hooked together, and the whole assemblage embedded in concrete.

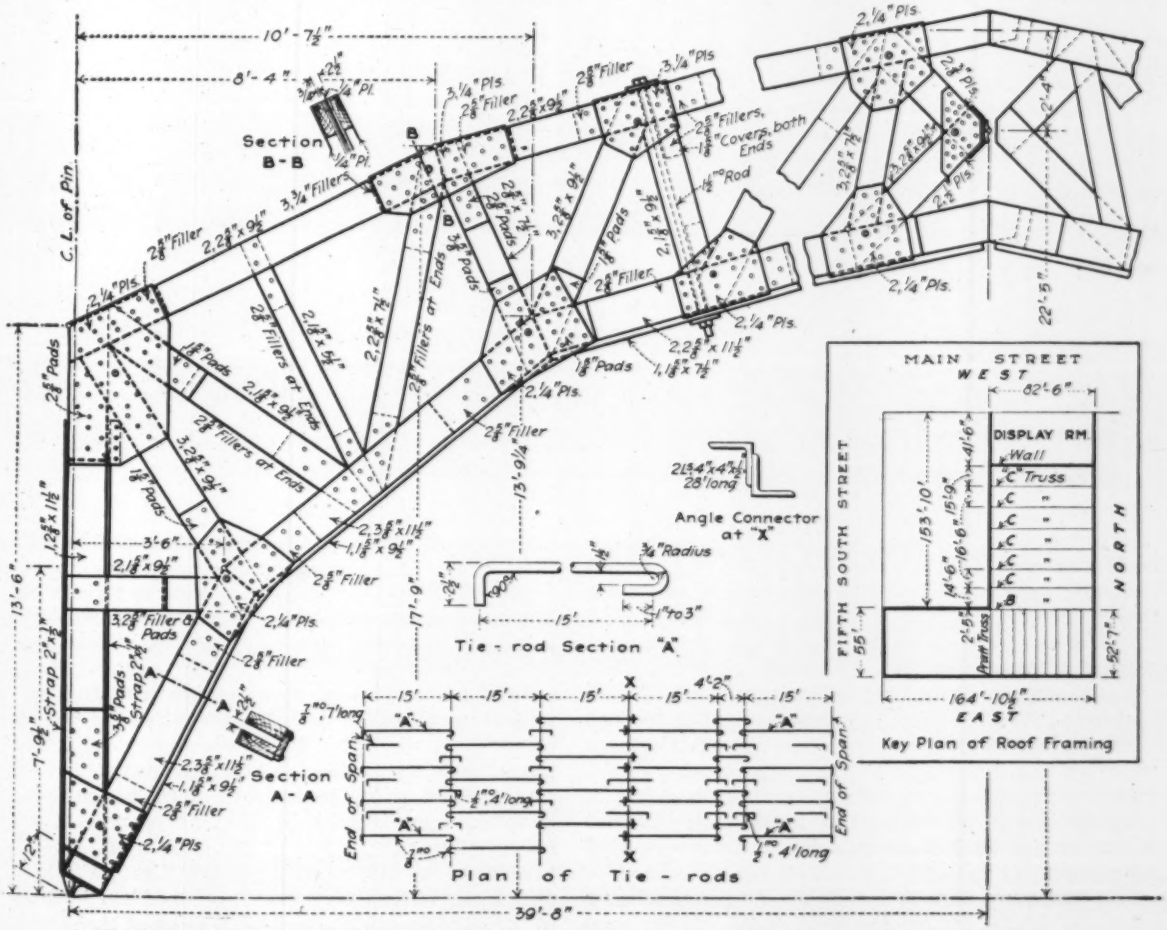
The garage service required a maximum clearance width so as to reduce the loss of floor space for moving about and storing automobiles. The arched outline was desired for its pleasing appearance. The three-hinged type of arch was chosen because of the greater simplicity and certainty of design.

The roof plan herewith shows the general layout. The trusses are 16½ ft. on centers, but one end truss must carry a set of purlin trusses of 53-ft. span and is therefore nearly twice as heavy as the others and has fully twice as large a weight-carrying capacity.

The adopted outline of arch involved end sections rising abruptly from the floor level to allow an automobile with top up to approach fairly close to the wall. This shape, however, throws the line of pressure of the arch outside the truss in the entire end section, which results in large tension stresses in the upper chord. While all members of the truss are of wood, the tension posts are reinforced with steel tie-rods.

The design of the connections was handled in exactly the same way as for a steel truss. It was originally planned to use spiked connections between web members and chords, but considerable uncertainty was felt as to the permanence of spiking, and a few experiments that were made did not give any reassurance on this point. The final choice was for bolted connections with steel gusset plates.

Live load was taken at 10 lb. for wind (vertical load



FRAMING OF HEAVY ARCH—TIMBER USED FOR TENSION AS WELL AS COMPRESSION MEMBERS

only considered) and 25 lb. for snow, to represent 4 ft. of freshly fallen snow. Computations were made with full load and with one-half span loaded. The total weight of roofing and trusses is 16½ lb. per sq.ft.

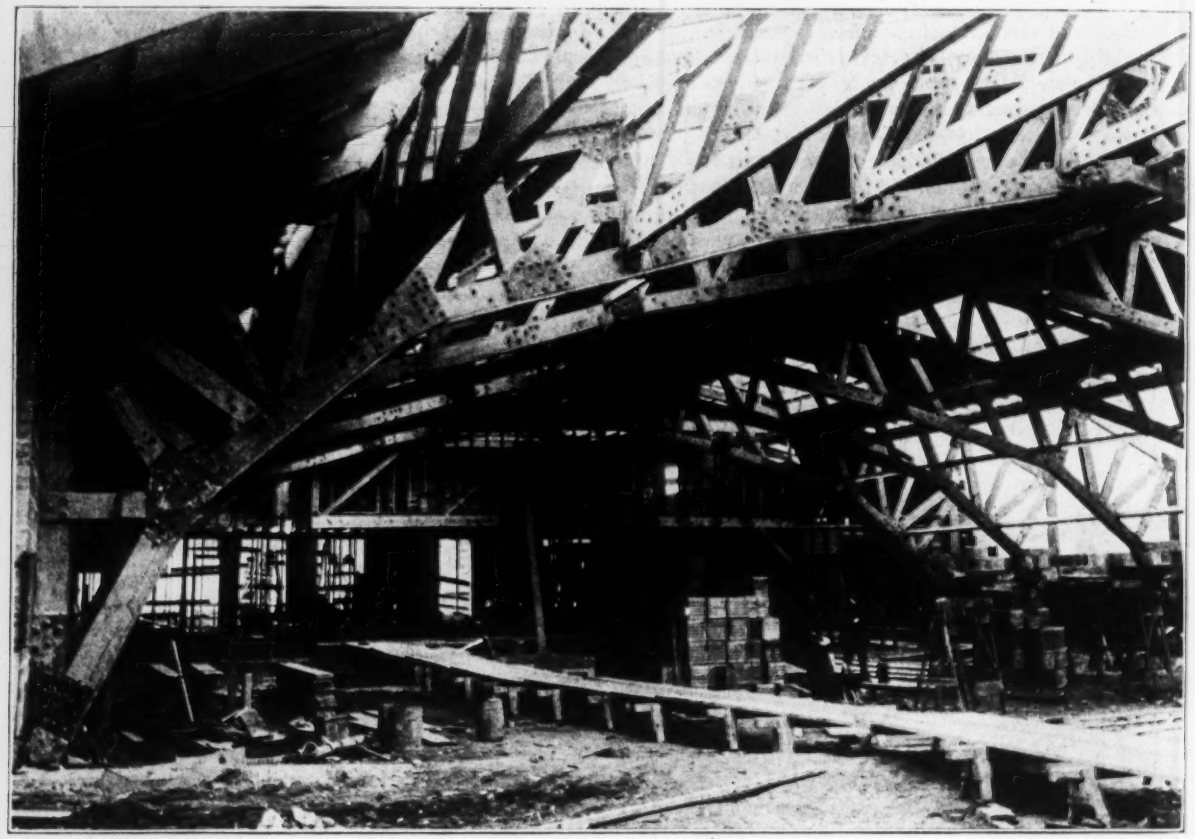
In proportioning the members the unit stress was not varied with the makeup of a member. However, where a member is built together of several pieces, undoubtedly a higher stress is permissible than when the same area is obtained out of a solid stick of timber; the probable influence of defects is much smaller in the composite member than in the one-piece member.

The connections of tension members gave so much trouble in detailing that in another similar case the tensile stress would undoubtedly be held down to 1000 lb. per sq.in. or less in order to simplify the connections and save a good part of the expense of gusset plates. The dimensions allowed with the stress of 1200 lb. were found altogether insufficient for making connections of economical size.

The hinge pins were designed for a pressure of 5625 lb. per sq.in. on the projected area, equivalent to 9000 lb. per sq.in. on ⅔ the projected area—the effective area according to a formula in "Hütte." The bearing of the lower shoes on the concrete was taken at 600 lb. per sq.in. The detail design of the shoes involved bending at 4000 lb. tension and 9000 lb. compression, and shear at 3000 lb. per sq.in.

The maximum thrusts are 49,300 lb. for the heavy truss and 23,400 lb. for the light truss. It was not considered safe to depend on the ground of adjacent property to withstand these thrusts, because of the danger of excavation for buildings on these lots. Tie-bars embedded in concrete-filled trenches under the floor were therefore used to tie the shoes together. No attempt was made to spread the thrust over the concrete foundations by reinforcing bars.

Plain bars were used for the tie-rods. Since the roof was built before the floor was laid, and had to stand through a time when the heaviest snowfalls of the year might be expected and the strain might come before the concrete had fully hardened, it was not considered safe to trust to the adhesion of the concrete and the bars to make the splice between successive lengths of these bars. At midspan the bars were passed through a pair of angles and fitted with nuts to tighten them. The intermediate joints are formed by hooking the ends together, the hooks being of 1½ in. inside diameter.



TIMBER-ARCH TRUSS GARAGE ROOF COMPLETED; HEAVY TRUSS IN FOREGROUND; LATERAL DIAGONALS PLACED AND CONNECTION BOLTS TIGHTENED AFTER TIMBER DRIED OUT

In the design of the tie-bar system, the sliding resistance of the concrete floor was taken into account. A friction coefficient of 0.25, the weight of the 6-in. floor being 72 lb. per sq.ft., develops a sliding resistance of the concrete on the dirt of 18 lb. per sq.ft. The adhesion of the bars to the concrete, at 80 lb. per sq.in., is more than enough to develop 288 lb. (for the 16-ft. width between trusses) per foot of bar. The arch thrust thus acts on the concrete as a compression directed from midspan toward the shoes; no assumption of tensile strength in the concrete is necessary. The effect of the floor fric-

tion amounts to a maximum of about 10,000 lb. per arch at midspan. The remainder of the arch thrust is taken by the tie-bar area at midspan. The tie-bars were also required to take at increased unit stress the full arch thrust before the concrete floor was laid and had set.

The trusses were laid out by full-size drawings on a platform of the size of a half arch, built on the ground near where the trusses were to be erected. The members for a half span were cut to fit the drawing, numbered, and then used as templets for cutting out the other trusses in the mill. This method was found to be cheaper and quicker than detailing the members in the office and cutting to the detail drawing.

After the pieces were sawed in a mill they were assembled on the platform and lightly spiked together. Then the truss was blocked clear of the platform, for boring the holes for bolts. Wherever gusset plates were to be used the upper gusset, which had already been punched, was laid in its proper place, the locations of the holes marked on the wood, the plate removed, and the holes bored by electric drill. Then the second of the pair of gussets (not yet punched) was fitted to the reverse side of the truss, marked from the bored holes and returned to the shop for punching. This procedure was adopted because of the difficulty of boring holes so straight through the wood that a good fit will result.

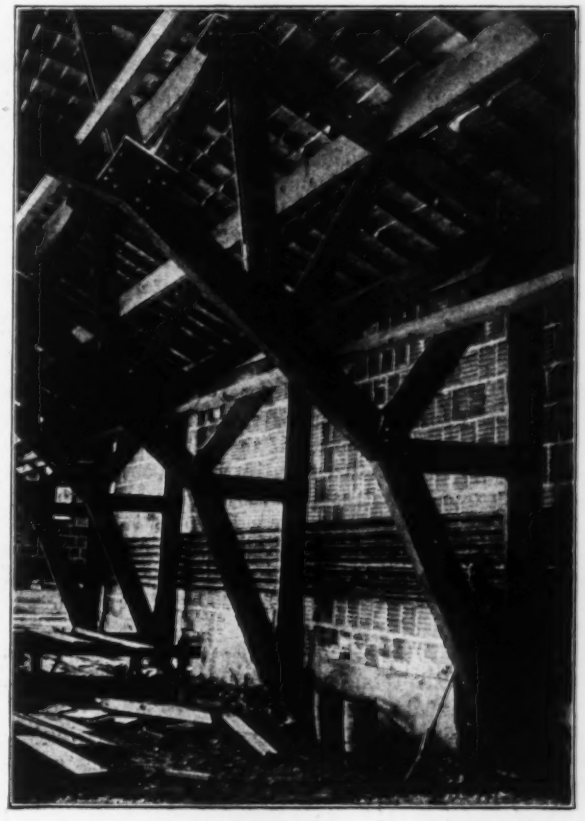
Where there were no gusset plates the exact spacing of holes was not shown on the plans. No confusion resulted from this policy. Many 30d. nails were driven to supplement the bolts. Some difficulty was experienced in obtaining enough ⅞-in. bolts. For this reason it is better to use the more common size of ¾-in. bolts.

The electric drill was a great labor saver. It never became so heated that work had to be checked to cool it, and it could work at the rate of 200 in. bored per hour.

The two half trusses of an arch were carried to place and laid on the ground flat, with the lower hinge near the lower shoe (previously set) and the center one on the ground underneath its finally erected position. The halves of the center shoes had already been bolted in place on the trusses. The half arches were then turned in upright position and the lower hinge joined up on either side, the central hinge still resting on the ground. Then one half arch was hoisted until the central hinge was at proper elevation, held by temporary guying and bracing, and the other half hoisted and lowered to bearing at the central pin.

The arches are stayed laterally by seven lines of 4 x 6-in. struts connecting the bottom chords, and diagonal bracing in one bay at each end of the building. The diagonal members are each made of two 2 x 8's spiked together, laid flat; they are held against sagging by a wire hanger at midlength, attached to a purlin above. The diagonal bracing was not placed until the building had gone through the summer, so that the timberwork had become dried out thoroughly. Then all bolts were tightened and the diagonals put in.

The weights of the trusses above lower pins are 10,800 lb. for the heavy arch and 6800 lb. for the light arch. These figures include both hardware and lumber. At the time of erection the lumber weighed 2.7 lb. per actual foot board measure, or about 2.2 lb. per foot of nominal board measure. Two months of drying out in a steam-heated office showed 16% loss of weight.



FLOOR AREA IS LITTLE OBSTRUCTED BY ARCHES

The writer believes that the attempt to save lumber by using pieces just large enough for the stresses and no more, which resulted in a great variety of dimensions, was a mistake and probably increased the labor cost more than the value of the lumber saved. As previously remarked, in order to provide for economical connection the allowable tension in Oregon fir should not exceed 1000 lb. per sq.in. The spacing between the two timbers of the chords should be enough to allow for two 2-in. boards, or 3¼ in.

With fuller data on spiked connections spikes would probably have been used in place of bolts. The weight of bolts is three times that of equivalent spikes and their cost in Salt Lake City about three times as much per pound. So far as used, spikes did not split the Oregon fir. The labor used in driving three 30d. spikes is less than boring the hole for and placing one bolt with it washers (approximately three spikes are equivalent to one ⅞-in. bolt).

A very important thing with all wooden roof trusses, whether arched or with flat chords, is to tighten all bolts after the timber has had time to dry and season. The writer believes that the failure of some wood trusses has been due to loosening of the bolts, which lessens their grips and permits lateral swaying.

The entire roof structure was designed by the writer for Villadsen Bros., Inc., contractors. The members of the firm, A. B. and Jens Villadsen, participated actively in the design and it was their original conception that a wooden arch truss be used. Thanks are due them for permission to use the photographs and plans.

Reconstructing a Sewer in Tunnel

Enlargement of Old 11-Ft. Bridge Conduit Beneath 50-Ft. Embankment Carrying Canal Invert Also Changed

RECONSTRUCTING an 11-ft. sewer in tunnel under a 50-ft. canal embankment presented some interesting problems for the contractor on a large sewer contract at Cincinnati, Ohio. The method of tunneling to be used was left to the contractor, subject to the approval of the city engineer. The contractor selected the method shown by the accompanying sketch. The work was unusual in that it required the removal of the arch of a four-ring brick sewer 11 ft. in diameter and the construction of a reinforced-concrete rectangular section on the springing line of the old brick sewer and the reshaping of the invert of the old sewer. The handling of the dry-weather flow in the old sewer and the necessity of the contractor always being ready to conduct his construction operations so as not to unduly obstruct the passage of the storm-water run-off from a residential area of about 2000 acres, or a calculated probable volume of water of 810,000 gal. per min. was a third feature of interest.

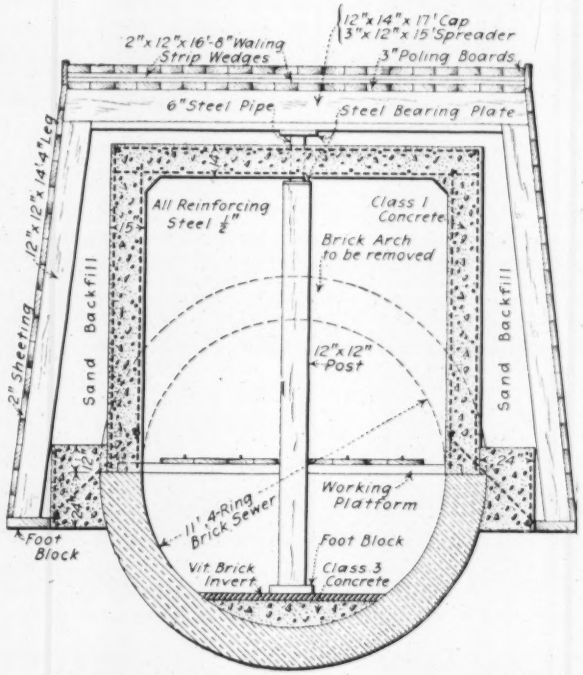
In timbering the tunnel the bents were placed on 5-ft. centers. The total length was about 300 ft. and the work was carried on from each end.

No particular difficulty was experienced in placing the tunnel timbering, but in each opening different conditions seemed to exist which caused the bents to move out of position. At one end, after the opening had reached the third bent, it was noticed that the balance of the bents back to the center were all leaning toward the opening. Their movement from the original upright position varied from 2½ to 11¼ in. in the direction of the center line of the sewer. The caps were found to be twisted longitudinally and also bowed, some downward and others upward between the leg and the center post. These effects were apparently caused by the heavy weight supported, the tunnel being in and through an old earth fill about 50 ft. deep, on top of which flowed the water of a canal. On the opposite end of the tunnel the bents from the first back to the fifth leaned toward the opening, but from the fifth to the center the bents remained in their original position. While the change of position and the bending and twisting were very noticeable no bad effect resulted.

It is to be noticed in the illustration that the center post stops just at the inside of the top slab of the sewer and that the extension of the post to the cap is by a piece of 4-in. steel pipe placed between steel bearing plates. The idea of changing from the wood section to the pipe was mainly for convenience in removing the center posts after the top slab was in place, and the pipe also permitted the regular spacing of the steel reinforcement. This 4-in. pipe was changed to 6-in. after the caps developed the twists referred to above.

After the first 10 ft. of excavation had been removed from the end of the first opening it was discovered that the old brick sewer had been constructed through a still older masonry culvert which was probably built at the time the canal was constructed, or about 90 years ago, and the traces of which were practically lost after construction of the brick sewer by the fills made in the adjacent low ground. Also additional work in removing the tunnel excavation was caused by the fact that at distances of about 10 ft. brick headers were constructed as fillers between the old stone arch and the brick sewer, in places amounting to seven additional courses of brick work. This masonry culvert was constructed on a timber foundation. It was necessary to remove a portion of the old timber in order to place the foot blocks for the timber bents and the little concrete haunch walls at each side of the springing line of the brick sewer.

A working platform was placed on the springing line of the old sewer, so built that it would float when the



THE BRICK ARCH WAS REMOVED, SEWER ENLARGED VERTICALLLY AND NEW INVERT LAID

water in the sewer rose above that elevation. This platform was anchored by cables which prevented its being floated away during high water. On this platform tracks were placed. Dump cars drawn by a cable were used to remove the excavated material and to carry in the concrete as well as the sand backfill.

During the time the new concrete-and-brick invert was being placed on the bottom of the old sewer the dry-weather flow of about 3500 gal. per minute was carried past the work in a wooden flume.

The greater part of this tunnel work was done during freezing weather, but the temperature within was kept above the freezing point by placing canvas curtains at each end of the tunnel and heating with salamanders.

This work is being done in connection with a contract for the Mill Creek intercepting sewer, the reasons for which were set forth in *Engineering News-Record*, Oct. 25, 1917. D. P. Foley of Cincinnati is the contractor, and the engineering work is being done by the city's Division of Sewerage, of which F. S. Krug is chief engineer, W. E. Sullivan, principal assistant engineer and George W. Wade, resident engineer.

The Engineer as a Social Force in the New Democracy

How He May Bridge the Gap Between Capital and Labor Pointed Out in the Presidential Address of Prof. George C. Whipple, Harvard University, Before the Boston Society of Civil Engineers

IN COMPLYING with the prescribed obligation of the retiring president to deliver a valedictory address, I cannot in these days of war speak of anything else than our own place in the great struggle and in what will come after. I have accordingly taken for my subject, *The Engineer as a Social Force in the New Democracy.*

The United States has been at war nearly a year. The victory is not yet won. But we are going to win it—that much is certain. We are going to win the war because we believe the cause of liberty is worth fighting and dying for, and because we have men enough who are willing to fight and die. We are going to win because American resources directed by American engineers, when added to the forces of our allies, will turn the scale of military power in our favor. Victory will come; but what will come after the victory? The world will be made safe for democracy; but how is democracy to be made safe for the world?

It is hard to look ahead, these days, and very hard to see clearly, but never was foresight so much needed as now. Engineers, as a class, have been trained to look ahead. To draw a plan is to look ahead—and the planners of our railroads, our water-supplies, our power distribution plants have seldom failed to exercise good judgment in forecasting the future.

Engineer Must Help Plan New Democracy

In recent years our forecasting has been largely on a mathematical basis, it has been a quantitative problem; but now the problem is different. Unless signs fail there is going to be a social reconstruction of the world. In fact, this is now going on before our very eyes if we will but see. Ferrero said that when Rome fell the Romans at the time never knew that it was falling.

The engineer must therefore extend his thought far beyond his usual bounds, because the new problem is not physical and mathematical, but rather political and ethical. The engineer must join with the members of the other professions, and what is more important he must join with the workers themselves, in laying plans for the new democracy and the new social order which seems destined to come not only in Russia but in England and Germany, in America, and, we may well say, throughout the civilized world. Because of his experience in looking ahead, because of his position as an intermediary between owner and contractor, between capital and labor, because of his habit of doing things in large ways, the engineer seems destined to play an important part in the coming reconstruction. The engineer's prominence in the war will give him added opportunities after the war is over.

It is hard to tell even in generalities what is going to happen, but some things seem reasonably certain Autocracy is going to give way to democracy in all of the great countries of the world. This means that to a greater extent than ever before the political power will be in the hands of the working people, that persons of limited education will have more direct control than now of the policies and actions of their governments. The relations between capital and labor are going to change; the wage system will be modified and may even give way to some other system of payment based on the idea of profit sharing. The great fortunes and the great holdings of land are going to be subdivided. The government may control not only the railroads, but other public utilities, as well as the basic resources of nature. We are going to live under new conditions, and, whatever our preconceived ideas, we must adapt ourselves to the new order. The changes will not come in a day, but they will come sooner than any of us would have predicted a year or two ago. Indeed, they have already begun.

Organization and Efficiency Inseparable

Democracies, considered as nations, are inefficient. History tells us that. Yet we need not go back of the present war to see it. An army is more efficient than a mob; an organized nation is more efficient than one not well organized; industry and transportation organized under the large corporation plan are more efficient than under the small unit plan. Organization and efficiency seem to be inseparable terms.

Where efficiency exists, the ruling power is almost invariably at the top and its branches extend downward, ever dividing as in the vagarious organization-charts which our bureaus of municipal research delight to draw. But what is meant by efficiency? Broadly speaking, it is doing much with little effort; it is getting out of a machine in one form the energy put into it in another form; it is making the most of the apparatus, the best use of time, accomplishing a result in the best way. In any measure of machine efficiency the thought is centered primarily on the result, secondarily on the power applied and the raw material consumed, lastly on the effect of the process on the machine itself. Under autocracy we see this idea illustrated in human society. The upper ruling power has a result in mind—it may be benevolent or selfish—the nation is organized to secure that result, all the units of the nation are required to work to that end, and the effect of the process on the constituent human units is regarded as a minor affair. The United States is temporarily and of necessity in this condition today. The object in view is to win the war; we are voluntarily organizing ourselves from the top down, to bring about this result; we are trying to make the most of our powers and resources; and we don't care what happens to any one of us.

But in times of peace conditions are different. Then the legitimate object of government is to provide conditions favorable for the life of each and every individual in the nation. The purpose of the nation is not ulterior, but interior. Efficiency takes on a new meaning. No longer is it a comparison between applied energy and material result, but a threefold comparison between process, machine and product, with the effect of the process on the machine as the controlling thought.

In mechanics we have no single word to express this idea, although we do speak of the "life of the plant," of "friction," of "depreciation."

In human society we have already some very old and very adequate words—health, comfort, happiness and contentment of the people—sometimes summed up in the word "welfare." In autocracy, efficiency means a comparison between work and result; in democracy, it should mean rather a comparison between work and welfare. Such relations might be called *beneficient*, to use an obsolete word with a somewhat new meaning —efficiency plus humanity.

Why Laborers Fear "Efficiency"

In this country, as in most civilized countries, we have striven for efficiency, and it is partly for this reason that the laboring people claim that we are an economic autocracy. It is well known that the movement for efficiency has not been received in a friendly spirit by the laboring people. Why? Because they believe that efficiency considers the work and the product and leaves them out. Beneficiency would mean placing the product and the effect on the worker in equal regard. The world is demanding that this change be made.

The present war is expanding in a most remarkable and significant manner. At the beginning it was regarded as a contest of nations; then it was seen to be a contest between national autocracy and national democracy; now it is becoming something still broader, a contest between social autocracy and social democracy the world over. We saw this first in Russia, and we viewed it with alarm; but when we see it spread over Austria and Germany we do not object, because it will tend to disintegrate our enemies. Do we realize that the same contest is going on in England and America? And when it comes, as come it will, how are we going to receive it? Our future tranquillity depends much upon the answer. Are we going to hold to the old idea of efficiency, and make the product of the nation the object of our work, or are we going to take the new view of beneficiency and place the welfare of the worker on an equality with his product, bending our present organizations to that point of view, lest they be broken altogether?

Worldwide Readjustment Inevitable

I hate the German nation as exemplified by the Prussian autocracy, with what, I hope is a righteous hatred, and I am confident that Germany will be beaten and her present rulers blotted out; but I do not believe that a mere crushing of the German military power will bring peace to the earth. I believe that a readjustment of political and social conditions throughout the world is inevitable, and that peace and tranquillity will not come until these great questions are settled. We talk with disdain about the revolutionists of Russia and the word "Bolshevic" has come to have a sinister meaning. But the ignorant, well-meaning Russian people are honestly seeking a way to build up a new democracy, social, political and religious, and we will do well to study their efforts. With their lack of knowledge and experience, with a dark background of brutal repression, they are making grievous work of it. We, with universal education, with more than a century of liberty and fre government as a background, ought to do better. Th Russians have the spirit but lack the education; we hav the education—do we lack the spirit?

The Engineer and Social Problem

Following the war the great problems of the da will be social problems, and the engineer must play hi part in them. As the great exponent of efficiency, it wil be one of his first tasks to alter the meaning of the term so that it will of necessity include a higher regard for the worker.

What is democracy? It was never defined better than by Lincoln: "A government of the people, by the people, for the people." The United States lives by these words today. Are we about to apply the same formula to public utilities, to business, to industry? It looks so. The workers are demanding a share in the control of their work. They will get it, and I believe they ought to get it. But Lincoln's formula does not say that all men are equal, that we should disregard experience and authority, or that we should relax discipline and abolish organization, or that service should be unrewarded and neglect of duty go unpunished. It is just as important for the workers to study their Lincoln—our Great Labor President—as it is for the men who manage business to study what he said and did.

Work and Its Rewards

The great contest will, as it always has, center around the problem of rewards. Few will deny that today rewards are disproportionate to service rendered the community in many of the walks of life.

Because the laborer has not received his fair share of the satisfactions of life he has endeavored to get them in the form of increased wages. It seems to me that in many cases this has gone too far. When a carpenter or a plumber or a bricklayer gets more money for his work than the engineer who directs the work—and this has happened repeatedly of late—when the laborer earns more than the small trader or the bank clerk or the school teacher or the clergyman, it shows that money rewards are not being given in accordance with what people are contributing to society. Granted that the big fortunes and the earnings of capital have in the past been excessive, it is probably true today that there is a strong tendency for the laborer to get too much money for the work he does. But when he gets it he still finds that he cannot procure with it the satisfactions of life; his extra leisure and his money are both spent unwisely. In other words, our money standard of rewards has failed. It has over stimulated enterprise, it has brought about an unwarranted inequality in the distribution of wealth, and it has not brought contentment either to the laborer or the capitalist.

Engineer May Be a Great Social Force

The engineer has a unique opportunity to be a great social force in the new democracy, to bring about harmony between work and the worker, to make work beneficient. The engineer is the planner of cities, the designer of factories, the builder of roads and railways, the distributer of power, the digger of mines, the operator of all sorts of industries. What has he planned

and built and operated for? Chiefly for product. He ought not to be criticized for that. It is a major element in the problem, and he has been content to consider that as his particular work. But the engineer has greater opportunities than almost any one else to make working conditions and living conditions better for the worker. The engineer is often the inspector of the work done. Why should he not also be the inspector of the worker, and see that his yoke is made as easy and his burden as light as it can be reasonably made? Specifications are drawn for the product of work, why not better specifications for the worker?

Labor Unions Show Signs of Change

The labor unions must have a change of heart if they expect to play the noble part in the beneficient democracy which they can play if they will. There are already signs of this change. The entrance of woman into industry is bringing conditions under which people work into the limelight, for women are by nature more influenced by their surroundings than are men. If labor fails to take the fair attitude, is selfish, and overreaches as capital has overreached in the past, the new democracy will fail. Unless American skilled labor adopts a broad-minded, constructive policy, in which the rights and welfare of all are considered, the pendulum will swing far toward proletariat control and then swing back to autocratic conditions. There should be a serious effort on the part of the engineer to prevent it from swinging too far in either direction.

Engineers perform five principal functions—they advise, design, inspect, construct and operate. In these functions they come close to capital on one side and close to labor on the other. The advisory or consulting engineer and the designing engineer are almost invariably employed by capital. The constructing engineer, the contractor, and the operating engineer are close to labor and the laborer's pay often goes through their hands. As an inspector the engineer's attitude is judicial. Sometimes these functions are bound up in one individual, but more often designing, construction and operation are in different hands. In fact, the contractor and the operator may not be regarded as engineers at all.

A Bridge Between Capital and Labor

One of the great underlying causes of present-day labor troubles is that the laborer does not understand what capital really is, does not distinguish it from so-called special privileges, from the unjustified control of the resources of nature. To the laborer, capital is impersonal. The laborer does not know the people whose savings make this work possible, or even the persons who handle these savings. Conversely, labor is likewise impersonal to the man of capital. In large establishments the employer does not individually know the people who work for him. This personal knowledge, each of the other, appears at first thought impossible of attainment in a complex civilization, with its enormous cities, its far-furrowed fields, its immense factories, its scattered mines. Individually it is impossible, but collectively it is not. The mine president cannot know all the laborers, but he can know some and through them the others. Not all of the laborers on a job can eat lunch with the big boss, but if a few of them did, once in a while, the acquaintance would be mutually beneficial. The greatest of all problems for the engineer is to help build a bridge between capital and labor. As a rule, the laborers like the engineer; they see him on the job, working in old clothes, measuring, planning, directing; they see him eat and smoke, and they regard him as a human being like themselves. They know, too, that the engineer stands in with the man who is furnishing the money to pay for the job. But to properly fulfill this intermediary position the engineer must broaden his ideas of efficiency from that of the most work for the least cost so as to include benefit to the constructing laborer as he constructs, and benefit to the worker who is to use the constructed plant.

[The remainder of Professor Whipple's address, dealing with the application of the broad principles here laid down to specific fields of engineering, will be abstracted in an early issue.—Editor.]

San Francisco Engineers Discuss Status of Profession

THE question "Why Have Not Engineers Achieved Higher Rank Among the Professions?" was discussed at a recent meeting of the San Francisco Association of Members of the American Society of Civil Engineers. Seven members who had been asked to prepare short talks on the subject were Prof. C. D. Marx, Maj. George L. Dillman, C. H. Snyder, C. J. Rhodin, H. D. Dewell, A. H. Markwart and R. S. Chew. Other views were brought out in the discussions that followed. A committee was appointed to study and bring in recommendations on the various suggestions. The following notes are taken from the committee's report.

There was a consensus that engineers should broaden their general knowledge of affairs; that in addition to a mastery of the technical side of engineering they should cultivate the ability to speak and write well, and after graduation endeavor to broaden by contact with other men, by taking part in civic affairs and by striving to develop administrative and executive ability.

Engineers Must Take Initiative

Both the public and the engineer would benefit, it was held, if engineers were more active in public affairs and had a higher professional standing in the eyes of the public and the other professions. If a change in the status of the engineer is to be brought about, engineers themselves must take the initiative. The question then becomes, What action is desirable?

The first step, the committee believed, is to establish clearly just what kinds of engineers are being considered and what distinguishes one class from another. The term "engineer" or even "civil engineer" is too broad to constitute a classification. As a starting point, therefore, the committee suggested three classes: (1) Those who plan or design, (2) those who assemble or erect and (3) those who manufacture or sell.

In other professions, it was pointed out, there are sharp lines of demarcation; the architect is not easily confused with the builder or with the manufacturer of building materials; the profession of the physician is distinct, and excludes the druggist and the chemical manufacturer. But civil engineers have not taken pains

to establish such distinctions. Commercial activity has become so closely identified with professional activity in civil engineering that even those involved have difficulty in drawing the line. The layman is naturally less able to do so and therefore a "civil engineer" is generally thought of as a man with more or less specialized training, engaged in a technical phase of commercial activity.

The committee pointed out the need for further study along this line so that there could be an agreement on definition and classification. Objectives particularly desirable, it was believed, are (1) an up-to-date definition of what constitutes a civil engineer; (2) an up-to-date definition of a consulting engineer; (3) the classification of civil engineers professionally into the three groups suggested, and (4) a statement of ethics or standards by which these classifications shall be established.

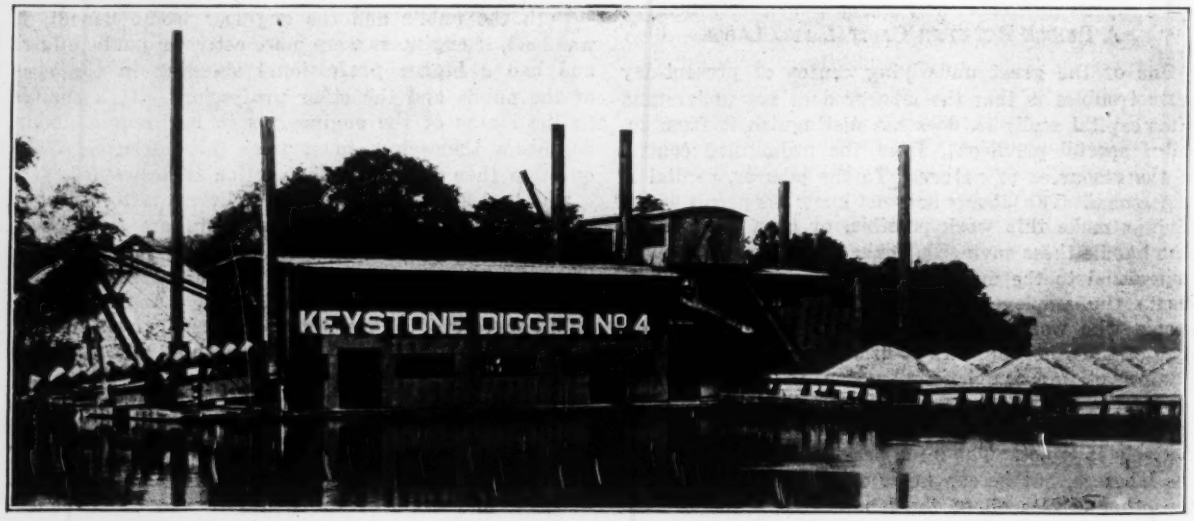
Large Sand Digger Has Main Screen on Deck

Though Extra Ladders Are Used To Raise Material for Loading Scows by Gravity, Cabin Height Is Cut to One Story and Output of Three Tons per Horsepower-Hour Attained in Ohio River Dredge

WHAT is said to be one of the largest ladder dredges used for dredging river sand and gravel in this country has recently been put in commission at the Neville Island, Pittsburgh, plant, of the Keystone Sand and Supply Company. With the main revolving screen set down on the main deck, and secondary ladders used to raise the sand and gravel from tanks in the hull to the chutes for loading barges, it was possible to bring within working limits a ladder capable of excavating to a depth of 50 feet below the surface of the water. This enables the boat to dredge to rock from pool stage, and to operate profitably during all but the largest floods.

The main ladder, the screen, and the two side ladders are all driven by the same engine, which has been found to develop 122 hp. under approximately full load. With uniform material, which is seldom encountered for more than a few consecutive hours, the dredge can handle 360 tons of wet material an hour, including ordinary delays. The spud engines are set below deck, the weight is carried low, the cabin is but one story, and the boat offers so little resistance to the wind that it can work under conditions which force the sand digger of the usual type to seek shelter.

As will be seen from the drawings, the dredge is built of steel throughout. On a dredge of this size one of the design problems is to keep the weight of the ladder down to a point which will permit easy handling while at the same time providing a ladder long enough to reach sufficient material to keep the dredge in operation at capacity. This problem has been solved on the other dredges by setting the main ladder with the driving tumbler as low as possible, and using a second ladder to hoist the material to the screen, which is usually set high enough to permit spouting the screened products directly into barges. This design results in a superstructure two or three stories in height, which in the large dredges offers considerable exposed surface to the wind and makes a craft that is unwieldy and even dangerous in storms. The dredge under discussion was designed in conformity with the established principle of keeping the main ladder as low as possible. Instead of hoisting the unwashed and unscreened material, however, the screen has been set on deck so that the main ladder discharges directly into it. The washed sand on one side and the sized gravel on the other are discharged from this screen into tanks built in at either side of the hull, from which material is hoisted to the chutes by two additional bucket elevators. In this way the total distance through which the dredged material is lifted is the same as in the ordinary design, except that the rejections are not handled in the second



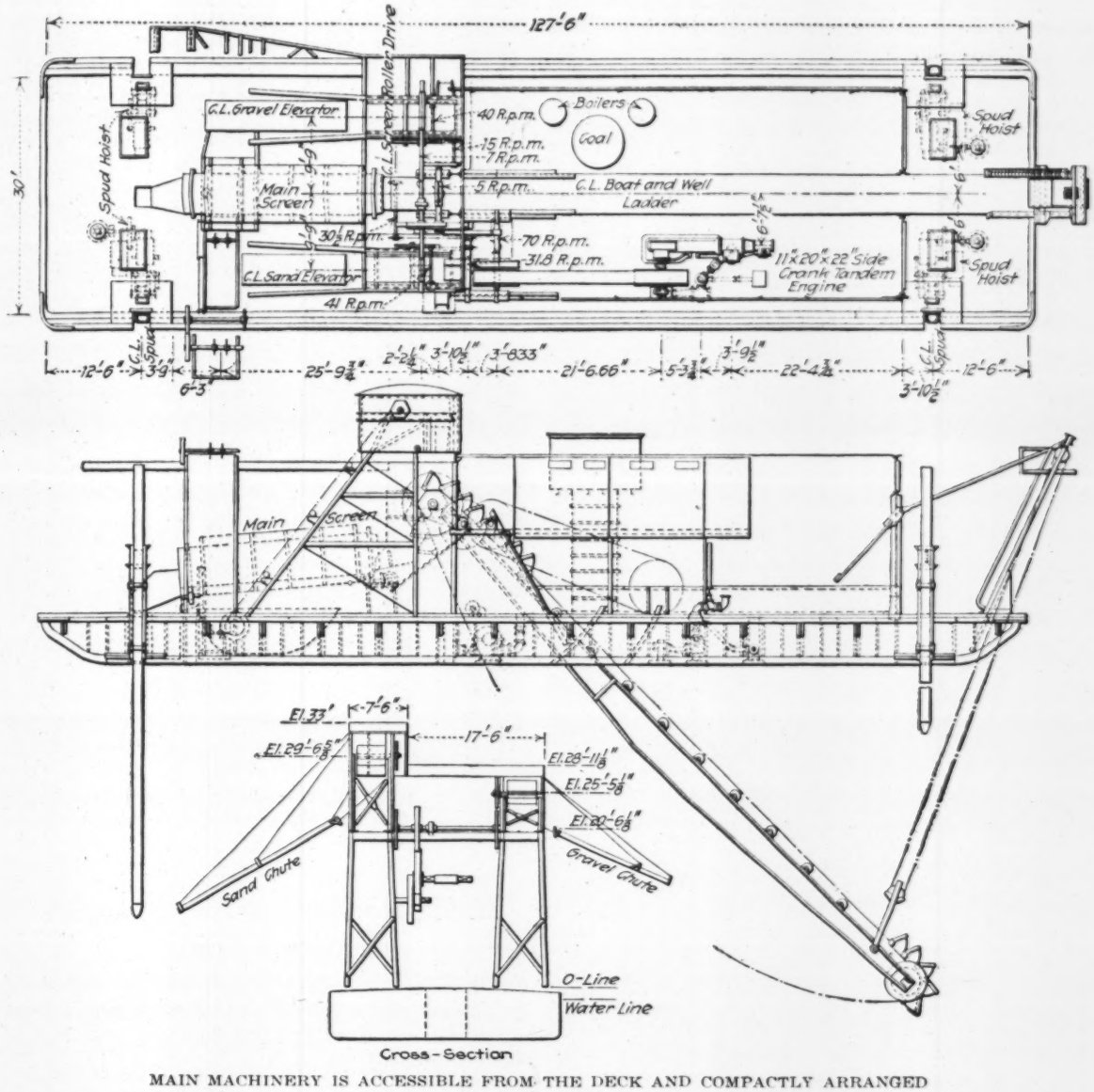
DREDGE CARRIES WEIGHT LOW AND PRESENTS LITTLE SURFACE TO WIND

lift. This plan also makes all of the machinery readily accessible, repairs being carried out under shelter and where there is plenty of deck room to work and handle spare parts.

Each one of the four spuds is operated by a separate spud engine located close to it and below the main deck, thus providing more deck room, which is desirable on account of handling the barges for loading. The main centrifugal pump is also set below the main deck and below the water line, so that it is self-priming.

The fuel bin is large enough to carry a week's supply of fuel. This can be charged either from a derrick boat or by means of a jib crane which is attached to the framework of the superstructure or coal can be loaded on the main deck close to the boilers from adjacent fuel flats.

All the main machinery of the dredge is driven by a tandem compound condensing engine, 11 x 20 x 22 in., which has been found to develop about 122 hp. This engine is belted to a countershaft, which in turn is geared to the main shaft of the upper tumbler of the main ladder. The countershaft also drives the smaller ladders and the screen by means of link belts. There are no clutches anywhere in the drive system, so that when the engine is started it is necessary for all three ladders and the screen to move.

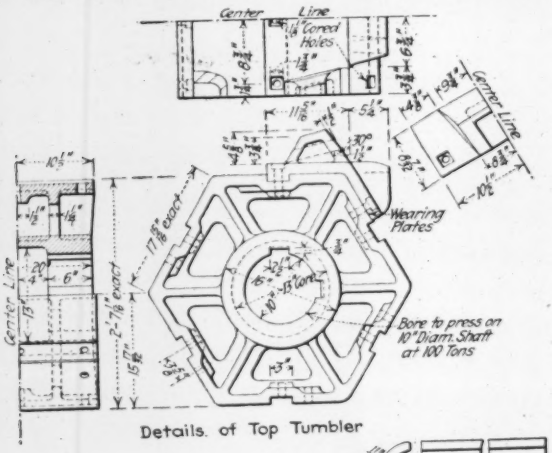


MAIN MACHINERY IS ACCESSIBLE FROM THE DECK AND COMPACTLY ARRANGED

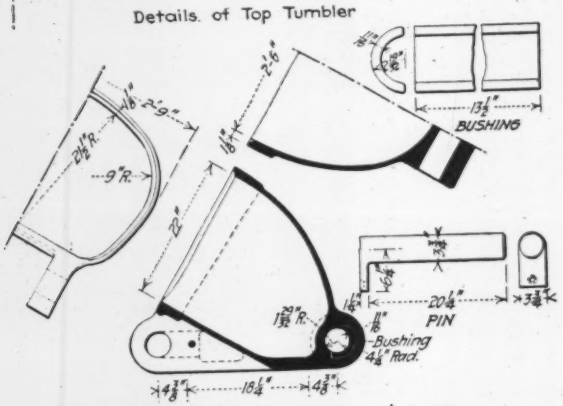
The ladders are all of the type used on the California gold dredges, with cast steel close-connected buckets. The shape of the bucket, however, is slightly different from that found in gold-dredging practice, as will be seen from the details shown herewith. The digging buckets on the main ladder, of 5¼ cu.ft. capacity, are driven by a hexagon tumbler which engages them with manganese steel wearing plates. All of the pins connecting the buckets in both the main and the side ladders are of manganese steel and run in manganese steel oushings. Manganese steel wearing plates are used also on the tumblers for the side ladders. These pins and

bushings, operating either in the water or under a constant flow of water, are relied on to run until renewal is necessary without developing undue wear or friction.

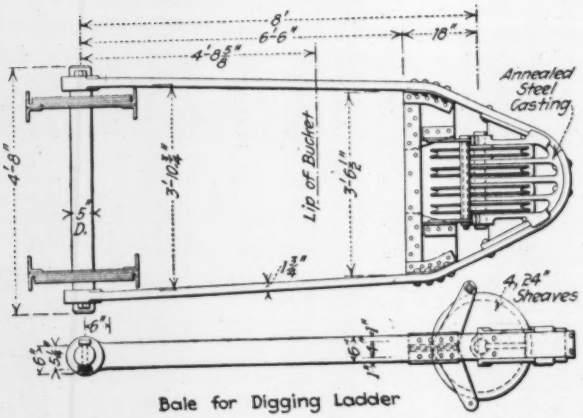
The main screen is double-jacketed, and receives all material passing the grizzly onto which the main ladder discharges. Large boulders slide over the grizzly through the main well of the boat into the river.



Details of Top Tumbler



Bucket for Digging Ladder, 5½ Cu. Ft.



Bale for Digging Ladder

DESIGN PRESENTS SEVERAL UNUSUAL DETAILS

Through the screen, a little above the center line, runs a 5-in. wash water pipe which is fed by the 10-in. centrifugal pump set in the hold. This pump supplies 2800 gal. of water per min. at 30-ft. head. The screen, 7 ft. 6 in. by 27 ft. over all, is set on a slope of 1 in 12 and makes 11 r.p.m. The 5-in. pipe mentioned is fitted with a number of nozzles, throwing the water against the contents of the screen in such a manner as to obtain the greatest washing effect. The sand passes through the inner screen to the outer jacket, and thence to the sand tank located on the starboard side of the boat. The gravel retained on the inner and outer screens passes to the gravel tank on the port side of the boat. The rejections from the screen are delivered into a well 2 ft. square built through the hull.

The two side elevators which raise material from the tank to the head of the loading chute on either side are of the same capacity, as the material recovered runs about 45 per cent. sand and 55 per cent. gravel. The chutes on either side are alike, made of sheet steel and able to discharge material at the end or through either of two traps controlled from the deck. In this way it is possible for a man on the deck to control the progress of loading from side to side of the scow, while the loading from one end to the other is controlled by warping the boat alongside the dredge. Six-hundred ton deck scows with 2-ft. high cargo boxes are used to transport sand and gravel from the dredge to the dock.

The product of the dredge is marketed in the Pittsburgh district, where sand and gravel of the sizes used in concrete are chiefly in demand. The output of this dredge at a speed of 5 r.p.m. for the main tumbler and with thirty 5½-cu.ft. buckets in the chain, would theoretically amount to 5000 tons in a 10-hr. day. However, it is impossible to operate continuously because of the necessity for changing scows, and moving location of dredge, which it is estimated consumes 2½ hr. of the day under ordinary circumstances. The output is still further reduced by the rejections, which may amount to 500 or 600 tons in a day's run. On this account the maximum output of the dredge is placed at 3600 tons a 10-hr. day.

The dredge, known as "Keystone No. 4," was designed and built for the Keystone Sand and Supply Company by the Dravo Contracting Company. The hull was built and launched at the Dravo company's Neville Island Yard, the machinery assembled and the digger completed within 200 yd. of where it is now engaged in recovering sand and gravel from the river bottom.

Rapid House Construction with Concrete Studs

Fire-Resistive Walls Made of Cement Stucco on Metal Lath—Frame and Wall Concrete Placed in One Operation

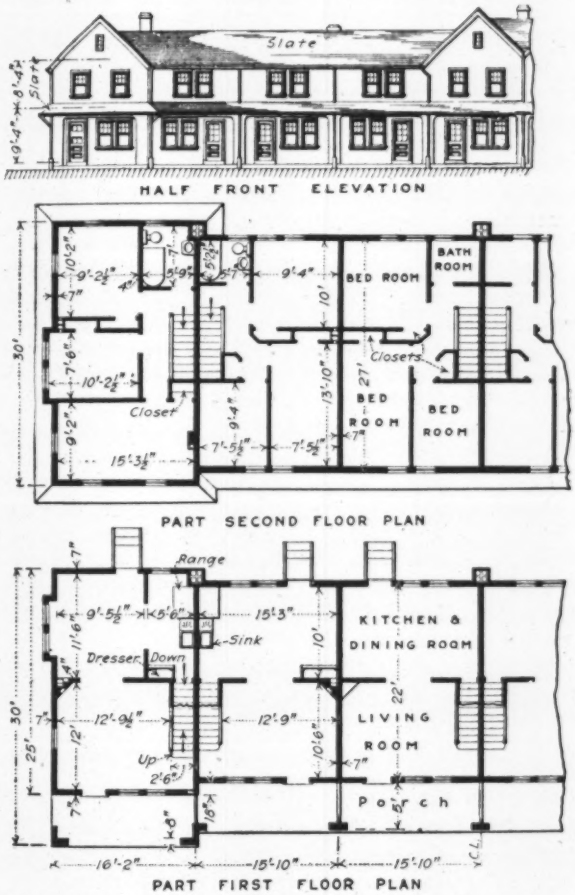
CEMENT-STUCCO wall surfacing in conjunction with a main frame of concrete studs and caps characterizes a new system of fire-resistent dwelling house construction proposed by Emile G. Perrot, of Ballinger & Perrot, architects and engineers, Philadelphia. The plan and the construction methods are under consideration for use in the large-scale housing work about to be started by the Government.

Built in ten-unit rows, as sketched herewith, such houses can be built at present material and labor prices for $2500 per house of six rooms, according to bids taken. This figure includes the cost of heating (hot-air furnace and piping). The price is as low as that bid on the same house of wood frame construction and shingle covering, and is $100 lower per house than

when 8-in. brick walls are used for exterior and party walls.

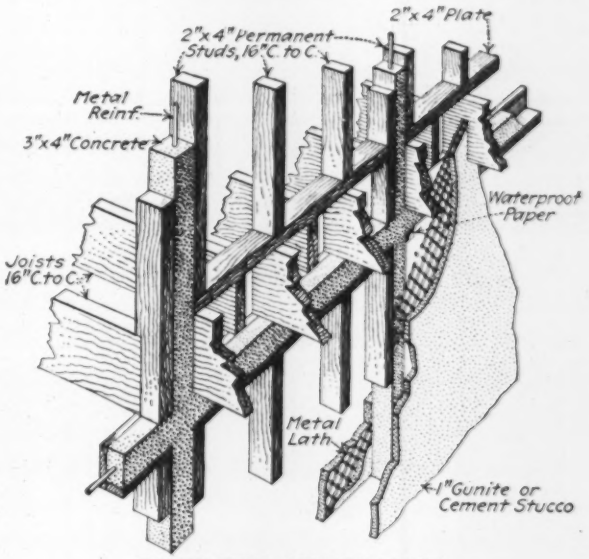
The design and the method of construction are interdependent. The concreting is carried on in one operation, in which both the frame members and the stucco are placed. The construction of such a house is thus described:

"After the cellar is excavated a stone or concrete foundation wall is built, and the first-floor wood joists are set in place on the foundation walls. On these joists a wood frame consisting of studs, joists and rafters is erected in the customary manner of building the skeleton of a frame house. Every fourth stud is



PART FRONT ELEVATION AND FLOOR PLANS OF TEN-UNIT HOUSE WITH CONCRETE STUDS

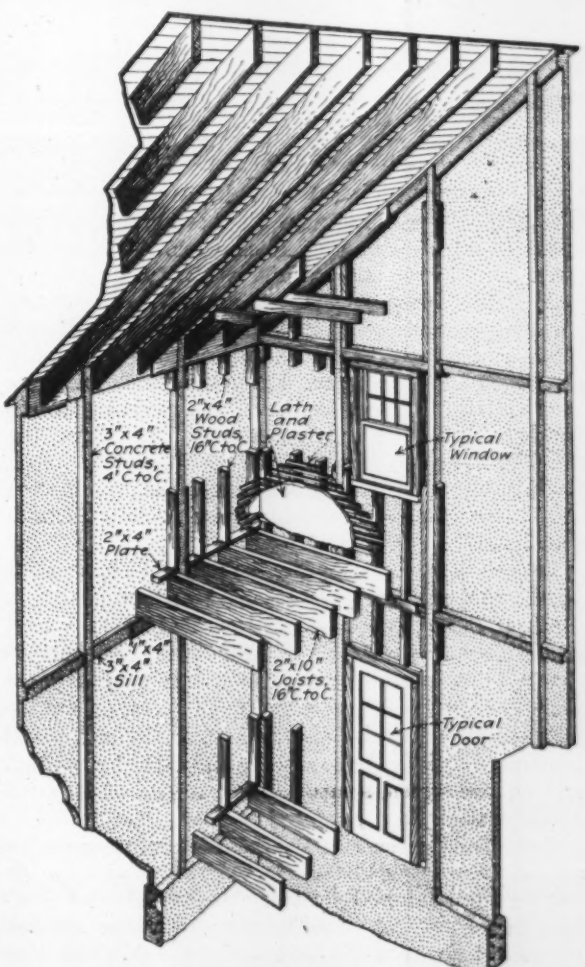
doubled, allowing a 3 x 4-in. space between, which is later filled with concrete to form a concrete stud. At the second-floor and roof levels a ledger board with bottom attached is placed over the studs and so arranged that the concrete studs when completed will be continuous from foundation to roof. On top of the ledger board the second-floor joists are set, then the second-story studs and forms. When this frame is completed, including the party walls, and the roof is on, heavy waterproofed paper is nailed to the outside of the exterior wall studs, leaving the space between the doubled studs open to receive the concrete. Over the waterproofed paper the metal lath or concrete reinforcement is stretched. The concrete studs are reinforced with steel rods fastened to the metal lath. The



PARTY WALL CONSTRUCTION

wood studs not only support the cement stucco while it is being applied, but also serve as furring strips in the finished building.

When all is completed to this stage, the 1½-in. or



FRAMING AT REAR CORNER OF END HOUSE

2-in. concrete coating on the outside is applied, and at the same time the spaces between the doubled studs and in the ledger boards are filled to form the concrete studs and caps. This work is preferably done with the cement gun, but if for any reason the cement gun is not available it can be done by hand. The rapidity of the work depends only upon the number of cement guns put into simultaneous operation, or, if the work is done by hand, the number of workmen employed at any one time."

A concrete roof can be used on such a house, but Mr. Perrot prefers wood roof framing and a fire-resisting covering (asbestos and asphalted-felt shingles, slate, and built-up roofings of felt, tar and gravel).

Among the advantages of the method of construction, according to the designers, are the elimination of shrinkage and settlement cracks through the use of concrete framing, and the fact that fireproof exterior and party walls are obtained at a cost no greater than that of wood-frame walls. In conjunction with these advantages, rapidity of construction is the distinctive feature of the method. A ten-unit house can be built in three weeks, it is stated, from the time the cellar is dug. The method of construction, shown as applied to workmen's houses, is considered to be well adapted for building barracks, hospitals and one-story factories.

Railway Engineers Accept Most of Committees' Recommendations

No Heated Discussions of Final Reports, and Few Sections Turned Back at Nineteenth A. R. E. A. Convention

RECOMMENDATIONS of fourteen committees of the American Railway Engineering Association were adopted at the convention last week. None of them were matters over which there was much debate this year, although two, that pertaining to the comparative cost of ballast and reinforced-concrete trestles and that relating to 24-in. depth of ballast, have been much discussed in previous years. Few recommendations were referred back to the committees. The matter approved will be published in a supplement to the *Manual*, pending the publication of a new edition of the *Manual*.

Roadway—With certain slight modifications the ten conclusions relative to the drainage of roadway through stations and yards were adopted.

Ballast—After several years the committee has accomplished the adoption of a standard section for 24-in. depth of ballast—not a stipulation that 24 in. should be used, but that where such depth is used the standard should be followed. Other conclusions adopted were paragraphs relative to cars and train operation for the handling of ballast, an endorsement of the mechanical tie tamper, conclusions adverse to ballasting by contract and an outline of the comparative merits of different ballast materials.

Rail—Specifications were adopted for quenched carbon and carbon alloy steel joint bars, to be substituted for the specifications for heat-treated, oil-quenched steel joint bars in the *Manual*. Specifications were also adopted for quenched carbon and quenched alloy steel track bolts with nuts, and for medium-carbon steel track bolts with nuts, to replace the existing specifications for track bolts. The committee's recommendations regarding the locations for physical test specimens and for chemical samples from rails were accepted.

Track—A design for cut track spike was adopted. Revisions in the *Manual* were accepted.

Buildings—Conclusions were adopted relative to provisions to insure safe walking in and about passenger stations.

Wooden Bridges and Trestles—The conclusion rejected last year, that creosoted timber trestles are more economical than concrete except when the cost of the concrete structure is less than one and one-half times the cost of the wooden structure, was adopted, together with analyses and tables supporting the conclusion. Conclusions endorsing the use of lagscrews instead of bolts and nuts were accepted, as were certain *Manual* revisions.

Masonry—Several pages of matter were adopted relative to premolded and cast-in-place piles. These embrace a classification and description of concrete piles, typical designs for premolded piles and specifications for constructing and for driving premolded piles. Some modifications were made in the text as given in Bulletin 204.

Signs, Fences and Crossings—Recommendations specifying dimensions of flangeways were adopted, as were conclusions relative to concrete fence posts; one conclusion adverse to the use of concrete posts in the general vicinity of salt water was referred back to the committee. Photographs illustrating different types of fences were approved for supplementing matter now in the *Manual*.

Signs and Interlocking—Designs for various fixed signs pertaining to the operation of trains were adopted. There were also adopted five plates of symbols, four of them being substitutes for plates now in the *Manual*.

Records and Accounts—The specifications for maps and profiles that have been before the association during the past year were adopted.

Water Service—With slight modifications rules offered for the care of boilers in pumping stations were adopted; the examination questions the committee submitted were withdrawn for further consideration. Rather extensive revisions in the *Manual* were approved; in the main they involved improved wording only, but two of them, relating to the tendency of treated water to foam, were designed to show the difficulty to be less than is implied in the matter now in the *Manual*.

Yards and Terminals—By a unanimous vote the catechism of yard design and operation (published in *Engineering News-Record* of March 21), together with the statement of principles preceding it, was adopted. The convention also adopted, with the elision of a small part relating to capacity, the specifications for track scales.

Iron and Steel Structures—Specifications that have been before the association for the past year, covering bronze bearing metals for turntables and movable railroad bridges, were adopted. The committee's three conclusions on column tests were also accepted.

Uniform General Contract Forms—An agreement form for industry tracks, a separate recommendation relative to the basis for division of cost of construction and maintenance, and an agreement for interlocking plants were all adopted.

Hinged Polygonal Steel Arch Carries Viaduct Spans

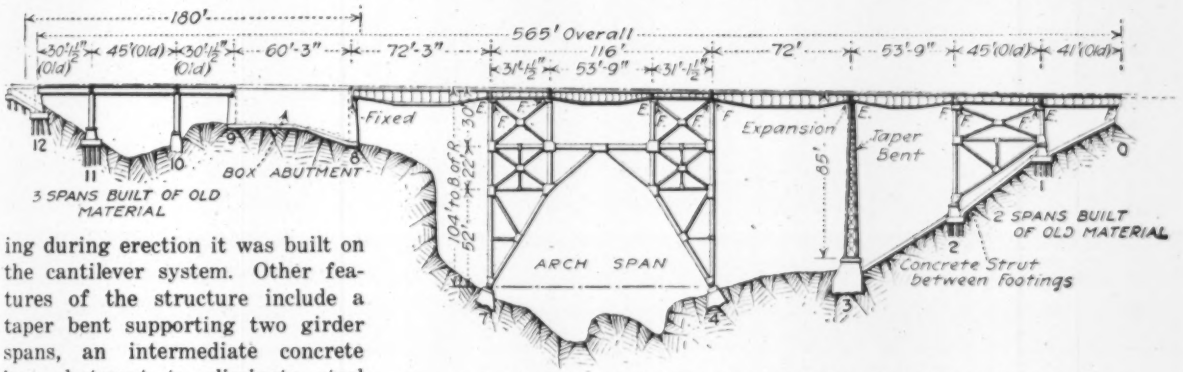
Plate-Girder Spans Supported by Novel Use of Arch Trusses Over Deep Gorge—Viaduct Approach Footings Braced Against Sliding

A POLYGONAL center-hinge riveted steel arch of 116-ft. span is the distinctive feature of the plate-girder viaduct carrying the Lake Superior & Ishpeming Ry. over the Dead River, near Marquette, Mich. The arch does not carry the deck directly, but posts of the arch trusses extend above the level of the crown and support plate-girder viaduct spans. The main reason for adopting the arch was to avoid the use of falsework, which was not feasible on account of the height of the structure.

The arch had to be designed to clear the old trestle towers and foundations, and in order to be self-supporting during erection it was built on the cantilever system. Other features of the structure include a taper bent supporting two girder spans, an intermediate concrete box abutment to eliminate steel spans, and the use of concrete struts to brace pier footings in loose ground.

Dead River is a turbulent stream at high water, and has a fall of about 15 ft. at the bridge site. The bridge makes a skew crossing of the gorge, which has a rocky bottom and a steep rock cliff on one side, while on the other side the slope is flatter and there is an approach fill. The track is on a grade of 1.63%, descending in the direction of the loaded ore trains. The old structure was 576 ft. long, with eight girder spans of 30 and 45 ft., a deck-truss river span of 96 ft., and 180 ft. of timber trestle. This was built in 1896, and was too light for the heavy engines which the railway intended to introduce in 1916.

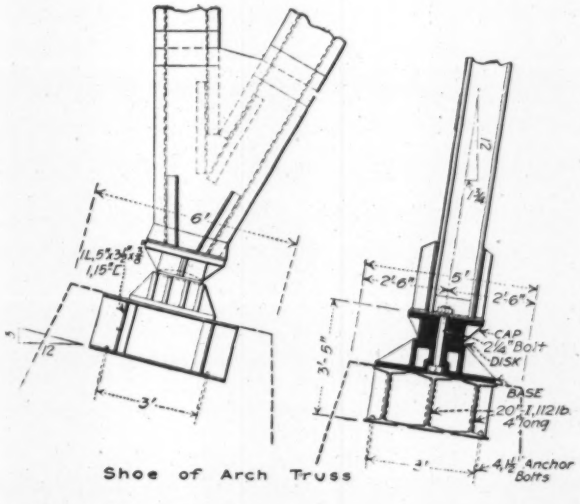
Built on the same center-line, the new structure is 581 ft. long, with eight plate-girder spans of 30 to 72 ft., carried by towers and bents in the usual way, and three girder spans carried by the 116-ft. arch over the river. It will be noted that the horizontal top chord of the arch does not form the deck of the bridge. The two vertical bents of each side of the arch trusses extend some 30 ft. above the arch, and carry a pair of tower spans 31 ft. 1½ in. long, between which is a girder span of 53 ft. 9 in. over the center of the arch.

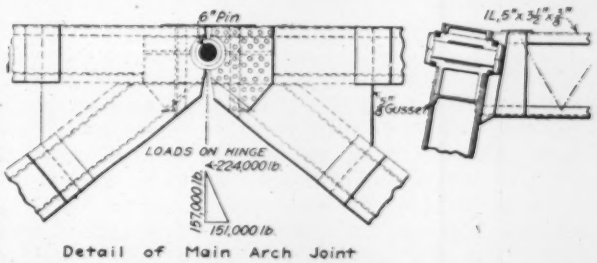


ELEVATION OF PLATE-GIRDER VIADUCT WITH ARCH SPAN

The proportions of the arch are unusual, there being a span of 116 ft. with a rise of 74 ft. The height from footings to base of rail at the river crossing is 104 ft., and from water level to rail level the height is 135 ft. In a preliminary design, a rise of only 50 ft. was provided, but with trestle towers 54 ft. high on top of this arch the heavy moments, due to traction on the grade of 1.63% made this arrangement unsatisfactory. In the adopted design, the rise is increased to 74 ft., and the height of trestle tower above the arch is correspondingly reduced to 30 ft., giving ample stability.

Two pairs of approximately triangular trusses form the arch, each truss having one vertical leg and one horizontal leg. The trusses rest on disk shoe bearings,





CROWN HINGE AND SHOE BEARINGS OF 116-FOOT POLYGONAL STEEL ARCH

and have a hinge-pin connection at the crown. Their sides have a batter of 1¾ in 12. Each of the main members consists of a pair of channels placed with flanges outward and having a cover plate on one side. Each member of the web system is composed of two or four angles.

The crown hinge in each truss is made with a 6-in. pin fitted to bearings in pin plates on the ends of the horizontal top chords. These plates have their ends cut away above and below the pin bearing, so as to permit of vertical movement of the joint under the influence of load and temperature.

At each foot of the arch, the vertical post and inclined chord are united as one member, the end of which is fitted with a shoe having a concave bearing surface. The base casting anchored to the concrete pedestal has a recessed top, in which is seated a plate whose upper surface is shaped as a segment of a sphere, fitting the concave surface of the shoe of the arch. Each of these three parts is a steel casting. The concrete pedestals are seated on bedrock, and have their bearing surfaces at an inclination of 1 on 4.

COMBINATION OF THREE-HINGED ARCH AND VIADUCT SUPERSTRUCTURE CARRIES RAILWAY ACROSS GORGE

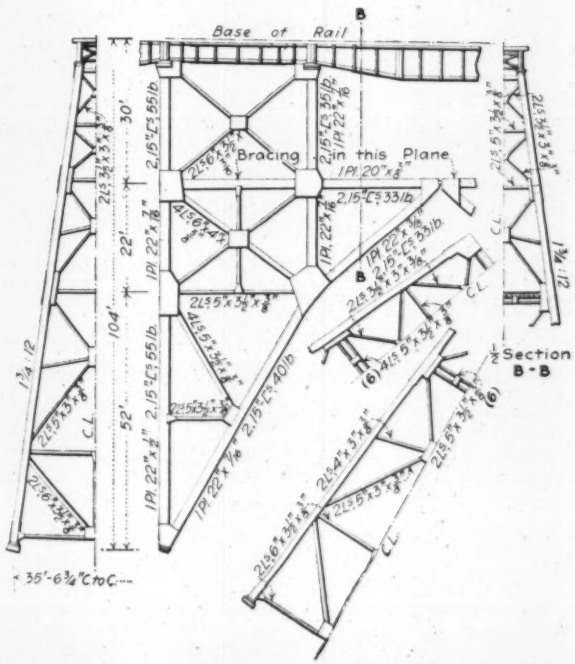
While the arch is the principal feature, there are other special points in the design. At the east end, the arch is flanked by four plate-girder spans, two of which have new girders, while the others are composed of old girders doubled up. The third span is carried by a steel tower. The adjacent ends of the first and second flanking spans are carried by a tapering four-post bent 85 ft. high, having a base 6 x 30 ft

Each leg is composed of two L-shaped members built up of a plate with two angles on the outer edge and one on the inner edge. This bent was introduced because it was considered that a full tower was not necessary or economical, but that some form of single bent possessing longitudinal stability was to be preferred.

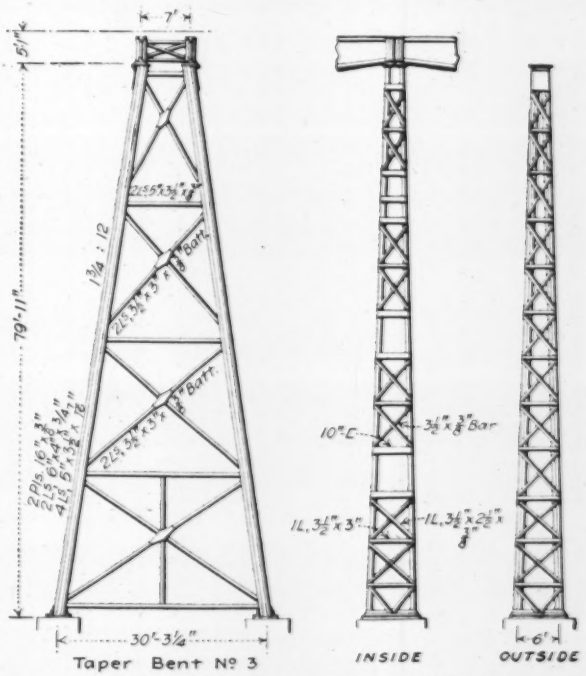
The new girders of the viaduct spans (except those of the towers) are of fish-belly shape, in order to effect economy of material and to clear the caps of the old columns. Where girders from the old structure are used, they are arranged in pairs, with two girders for each side of the span. Those of each pair are spaced 15 in. c. to c. of webs, and are connected by diaphragms; the diaphragms and the lateral braces were made up in the field from material of the old structure. The three separate spans at the west end are of old girders doubled up and connected in pairs, as described. Their steel bents are built up of columns from the old bridge, cut to length with a gas-torch. They rest on concrete pedestals and footings. Wood foundation piles are used under those footings which could not be placed on rock, and also under the small U-shaped end abutment.

Unfavorable foundation conditions on the east side of the river made it necessary to provide against longitudinal movement of the pedestal piers. The abutment and the footings of the first two piers are built in the end of a large sand fill, which is somewhat unstable. The next pier, which is that of the taper bent, is built on solid rock. Concrete struts at the ground level are placed between the abutment and the intermediate piers, thus bracing them all against the third pier, which is made of such weight and shape as to resist the thrust.

A concrete-box intermediate abutment divides the steel structure in two parts. Flanking the west side of the arch is a plate-girder span 72 ft. 3 in. long.



ARCH MEMBERS BRACED BY SUPERSTRUCTURE FRAMING



TAPER BENT AND TOWERS OF VIADUCT

Between this and the three end spans is a concrete box 60 ft. long, near the edge of a cliff. This is built on a rock ridge which comes within 20 ft. of the rail level, and thus permits a reduction in cost by eliminating a stretch of steel superstructure. The end walls are abutments proper. They are connected by side walls which are held together by transverse steel tie-rods and are anchored to the rock by dowels. This box is filled with earth, upon which is laid the track ballast.

The spans were so arranged as to bring their supports between those of the old structure, in order that erection would involve a minimum of interference with or alteration of the existing work. The erection was carried on during the winter of 1915-16, when the ore traffic had ceased and traffic was light.

The bridge is designed for Cooper's E-60 live-load. Wind pressure is taken at 30 lb. per sq.ft.

Some of the special or novel features of the design were introduced on account of the necessity of keeping clear of the old structure and maintaining the line open for traffic during erection. Thus it was necessary for the new girders to clear the caps of the old steel bents, these caps being very high on account of the shallowness of some of the old spans. Then the new girders for the spans over the arch were spaced close enough to clear the old 96-ft. deck-truss span, thus permitting the removal of this span for use elsewhere.

Design, manufacture and erection of the structure were all in the hands of the Wisconsin Bridge & Iron Co., Milwaukee. Information and plans have been supplied by J. F. Jackson, who until recently was vice president of the company. The foundations and concrete work were done by the railway forces. All construction was under the supervision of R. C. Young, chief engineer of the Lake Superior & Ishpeming Railway.

Highway Problems Considered Under Ten Main Heads

Bond Limitations, Better Drainage, Lower Grades, Traffic Study, Better Types, Load Limits, Safety Factors, Adequate Maintenance, Laboratory Control and Opportunities

Extracts from a Lecture by H. Eltinge Breed, First Deputy Highway Commissioner, New York State, before the Roads School of Michigan University

IT IS well that road schools have been inaugurated. It is part of a great work, for the highway is perhaps the greatest single factor in the advance of civilization. In the development of this country the railroads came into the ascendancy in the last half century, but today the highway, on account of war necessity, has again assumed its proper place in the activities not only of this country but of the entire world.

We are now at the start of a movement which, in spite of the huge expenditures involved during the past ten years, is still only a beginning. When, in 1928, we will look back upon the appropriations of the preceding ten years, they will make the expenditures of today, large as they now seem, rather insignificant. A few years ago almost beyond hope, today a start has been made toward a national system of highways which will connect every port and center with every remote village and hamlet, so that the whole nation may at all times give its whole strength to the nation's need.

So many factors enter into the conditions which are determining the trend of highway work today and the ramifications of the work are so many, that only the most important can be selected for treatment at this time. If I should briefly and at first outline the ten conclusions which I expect to consider, the scope of my reasoning will be more readily grasped. These conclusions, or main heads, are as follows:

(1) Bond issues for financing highway improvement should not be made for periods greater than the life of the pavement, except for such permanent improvements as alignment and grade.

(2) More complete drainage should be procured. This is not exactly a novel proposition, but it will stand reiteration even unto the thousandth time.

(3) Rise and fall should be carefully determined on a basis of cost of haulage. We must balance the lump cost of leveling against the aggregate saving of motive power.

(4) Essential to proper design is a definite study of the increased traffic which a route will invite to itself after completion and when it becomes a link in a system.

(5) It is absolutely necessary to build better and more permanent types of pavement.

(6) We must limit the size of the maximum load and place some regulation upon motor truck traffic.

(7) Additional factors of safety should be employed as part of a general system of social economy.

(8) An adequate scheme should be developed for maintenance, renewal and reconstruction from the day of completion on.

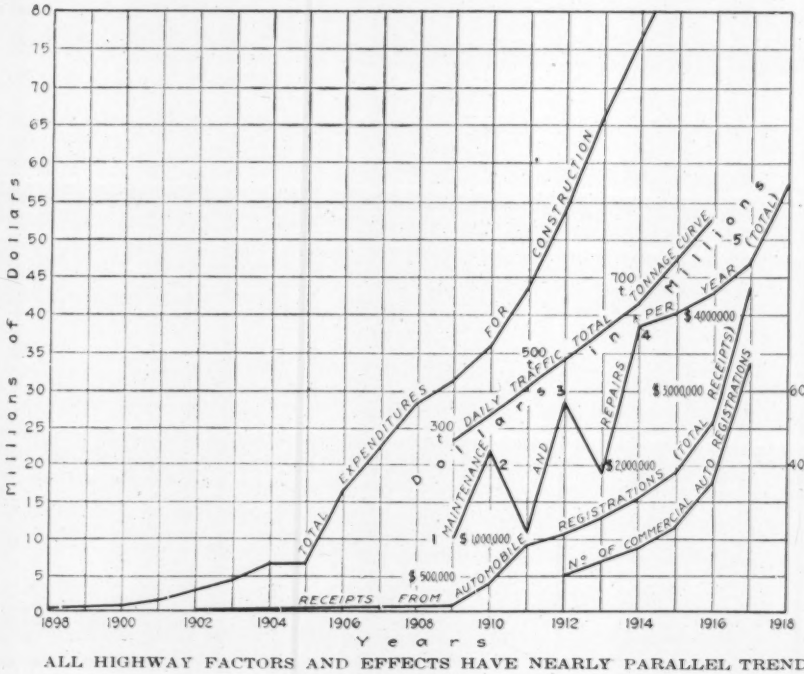
(9) Laboratory control is cheap insurance for road construction.

(10) There are many opportunities for the highly trained engineer in highway work.

Such are the ten conclusions. Now, before discussing the details of each, let us consider briefly the general conditions that have produced them.

The building of roads today has changed remarkably from what it was even a few years ago. Yesterday we were building roads for traffic of from one to three tons; today while we are building roads to withstand traffic of from one to ten tons, the traffic actually runs to a maximum of twenty tons; and for tomorrow, unless some limiting legislation saves us, we know not what to provide. This much is certain: First, motor truck traffic has come to stay because it is a solution of the problem of transportation and railroad congestion; second, motor truck traffic is so much the greatest destructive force upon our highways that consideration of it must dominate all plans for construction.

The motor truck has become the assured agent for



ALL HIGHWAY FACTORS AND EFFECTS HAVE NEARLY PARALLEL TREND

much short-haul traffic and for transporting products between the farm and the railroad. In order to grant relief to terminal facilities and release freight cars for long-haul operation, it has been wisely suggested that the motor truck should take care of all short-haul traffic up to distances of 100 miles. This would relieve, for long-distance work, freight cars the greater part of whose time is now consumed in being loaded and unloaded. It would pay the shipper to use the motor truck because it would assure quick delivery and save the expense of extra handling when labor is at a premium—as it is today and probably will be for many years to come. There is also another saving in cost which comes from the lessened handling in packing and crating. This use of our highways for short-haul freight traffic would not only release large numbers of cars which seldom, if ever, carry capacity loads, but would also relieve congested terminals by decreasing the total number of cars they must accommodate. But such a use of our roads necessitates a very different type of construction from that designed for the traffic of even five years ago.

Some statistics in regard to the number of motor cars in the country at this time may be of interest. There had been registered in the country during 1917, 4,842,139 motor cars. Of these 435,000 were motor trucks. It is estimated that the tonnage of goods hauled that year was 1,200,000,000. The cost of haulage by motor trucks at 18c. per ton mile amounted to $1,080,000,000. The number of persons in the United States to one motor car was 24; the number of persons to one motor car in 11 middle western states was 17. The percentage of cars sold to farmers in 1917 was 40. The number of automobiles in the United States to each mile of public road is 1.72; the number of automobiles in the United States to each mile of surfaced road is 14.77.

On the same basis as the figures above given, there were 418,000 motor vehicles in New York State. It may be interesting to give the number of motor vehicles in New York State since the bureau of licenses has been operated by the Secretary of State:

1911	83,969	includes both passenger and commercial
1912	105,749	
1913	118,996	passenger
	13,932	commercial
1914	151,059	passenger
	17,369	commercial
1915	208,212	passenger
	23,619	commercial
1916	279,048	passenger
	35,100	commercial
1917	411,567	divided as follows:
	338,682	passenger
	11,932	omnibus
	55,402	commercial
	985	trailers
	2,728	dealers
	1,838	exempts

Now, with this basis of general conditions before us, let us revert to each of our conclusions.

Bonds Regulated to Life of Pavement

The first was that bond issues for financing highway improvement should not be made for periods greater than the life of the pavement. Some examples seem to justify this conclusion. Let me quote Borough President Dowling of New York City, as saying: "The life of a pavement is eleven years. . . . The average life of a pavement in New York City before the advent of the automobile was 15 years. The medium weight of the automobile reduced this average to eleven years."

Supplementing this, E. W. Stern, chief engineer in charge of highways, Borough of Manhattan, gives some interesting figures about sheet asphalt on concrete foundation completed July 22, 1912, and about improved granite block on concrete foundation completed Feb. 26, 1913, both of the most improved type and laid under the best specifications. Within a period of nine months each was badly broken down, in some places even to the shattering of the concrete foundation; 32% of the area of the granite had to be relaid at a cost of $6000, and 30% of the asphalt at a cost of $1530. Under ordinary city traffic, the maintenance cost of the granite would have been $150 and of the asphalt $70. This damage was done by motor truck and trailer. The trailer carried about 15 tons on steel tires 8½ in. wide, the load per inch width of tire being 1400 lb. But the point is that while this of course is an exaggerated case, it shows the utter folly of bond issues of 25 to 50 years for pavement. Fifty years is the term in New York State. You can imagine the zest with which, some 40-odd years hence, our descendants will be paying for those shattered pavements.

Average Age of Roads

The average age of our waterbound country roads in the past has been about seven years before partial or total reconstruction with a maintenance cost of 4c. per sq.yd. per year. For our bituminous macadam roads, penetration method, the average age is about nine years to time of reconstruction. From an inspection of our records it appears probable that the average life of the waterbound macadam and bituminous macadam built during the last five years will prove to be considerably shorter than that of their predecessors. Many of them already have had to be partially or entirely reconstructed in less time than the average age given above, in spite of the fact that we are building better and heavier construction each year. Surely then the period of indebtedness for such pavements should be shortened.

Including excavation, the cost of permanent improvements to a highway runs about $5000 per mile. This is about one-half the cost of a waterbound, one-third the cost of bituminous macadam, penetration method, one-third to one-quarter the cost of concrete and one-fifth to one-sixth the cost of brick. This percentage indicates the amount that can be bonded for a long period; the rest of the money should be raised for periods of from 5 to 15 years, depending on the type of pavement used.

My second conclusion was the necessity for better drainage. This seems an elementary topic, but like many other self-evident truths, it too often is neglected. Drainage problems are considered so easy to solve that anyone may adequately handle them. True, there is but little theory involved in the application of the principles that make for perfect drainage, but that rare quality known as judgment comes in largely here, as it does in all successful engineering work. Greater care and judgment in respect to drainage are needed now more than ever before in order to increase the bearing power of our soils for the heavier loads that the traffic of today brings upon them.

This topic may seem more worthy of attention when I tell you that in 1916, 84 miles of improved highways in New York out of a total of 1939 miles, broke up in the

spring of the year. Of this, 43% was directly attributable to inadequate drainage. During 1916 about 75% of these weaker areas was repaired and 238 miles of thin pavement was resurfaced. It may have still more force when I tell you that in New York State in 1917, 48 miles of improved highways out of a total of 2090 miles broke up in the spring of the year of which 18% was attributable to inadequate drainage.

The percentages given as attributable to inadequate drainage were reported by the men having charge of each section and the personal equation enters largely into the cause to which each break-up was made attributable. They are, however, the most accurate percentages that could be obtained of the inadequacies of our drainage systems. These roads were not built by guess but under careful calculation by some of the best road engineers in the country. They installed upon them drainage systems such as they thought ample, but they had not taken into account the large increase in traffic and wheel loading that we have today. The roads failed because they disregarded the pumping action caused by the excessive pounding of that traffic, which draws the water and fine material up to and through the crust of the pavement until the crust is broken and the road shattered.

I shall not attempt to suggest any scheme for the solution of the drainage problem, because each condition requires different treatment. Broadly speaking, however, drainage can be divided into two classes: surface drainage, and sub-surface drainage. Surface drainage is cared for by the crown of the road and side ditches with proper run-off to carry the water away from the road at frequent intervals so that it will not trouble us again as sub-surface drainage. Every roadway should have ditches.

Sub-Surface Drainage Essential

Sub-surface drainage is important because the ability of earth to sustain a load depends largely upon its moisture content. As this increases the original firmness is lost. Firmness decreases while settlement and displacement occur and the finer particles may be drawn up through the interstices of the crust or pavement by the pumping action of the loads passing over the road.

Another destructive agent which depends upon the amount of moisture in the material is frost. Frost does not affect dry material, but is a danger to earth that contains water. Therefore, if we wish to develop the greatest bearing power for any given soil we must keep it dry—that is, prevent water from reaching the road by providing adequate drainage, and also provide means to take away such water as comes to the road underground by lowering the water table or water level. If this work is properly done there will be a large saving in the foundation or thickness of crust necessary to withstand given loads.

The third conclusion was that rise and fall should be carefully determined on a basis of efficient cost of haulage. Broadly speaking, rise and fall is the sum of the differences in elevation between the two termini of the stretch under consideration, but for a basis for a solution of this problem minor undulations may be disregarded, since ordinary momentum will carry the load over these. These differences of elevation and the consequent work required to raise the load to summits should be taken into consideration in the laying on of the grade line.

This determination is just as much a part of road economics as it is of railroad economics, where it is carefully taken into account. It may best be illustrated by an example. Let us assume 1,000,000 tons of traffic per year—that is, 4000 tons a day for 250 days. We know that one gallon of gasoline (58° Beaume test) = 96,472,000 ft. lb. If the gasoline is 25% efficient it equals 24,118,000 ft.lb. Therefore, a rise of 1 ft. would take $\frac{1{,}000{,}000\ tons \times 2000\ lb. \times 1\ ft.}{24{,}118{,}000} = 83\ gal.$ of gasoline which at 25c. = $20 approximately. This capitalized at 5% would equal $400. We could usefully spend $400 to lower the summit of a hill one foot.

From the foregoing you will see that we can usefully spend 10c. a ton for the daily tonnage to eliminate 1 ft. of rise or fall. In other words, with a daily tonnage of 3000 we could usefully spend $1800 to cut the summit 3 ft. and raise the depression 3 feet.

The above example will not apply to all problems of this nature. It is given only to show the possibilities for study. It applies in two cases: one, where the distance is not changed and only the summits are lowered and the depressions raised; the other, where the gradient is reduced by a new location and a change of distance. The rate of grade affects only the economy of heavier loads with the same power and must be considered only as the virtual grade. Virtual grade is the equivalent grade resulting from taking momentum into consideration. If in any problem you may have to consider the automobiles and trucks approach the foot of a hill at an average speed of 25 or 30 miles per hour and reduce the speed to 10 miles per hour at the top of the hill, it is apparent that a large momentum stored in the high speed at the bottom of the hill is exhausted in climbing the hill. The work the engine does is the work necessary to propel the car up hill at a uniform rate of speed, minus the work done by the momentum lost in the reduction of the rate of speed.

Traffic Census Should Be Made

The fourth conclusion was that essential to proper design is the result of a definite study of the increased traffic the improved road will incur. The importance of this is best illustrated by the figures taken from the traffic census of an average of 11 roads in representative sections of the state outside the large cities. From 1909 to 1914 there was an increase of 216% in the motor vehicles and a decrease of 11½% in horse-drawn vehicles on these roads. From 1914 to 1916 there was an increase of 66% in motor vehicles and an increase of 12% in horse-drawn vehicles. I give these figures merely as indicative of the increases.

The study of traffic conditions should begin with a census taken upon the road to be improved. This will have relative value only, but it may be interpreted through a comparison with similar roads which have been improved, considering also the density and kind of population to be served. The existing transportation facilities in this territory and their adequacy for present and future needs will be no small factor in the increase of traffic.

Funds for building are not unlimited, so our design must take into consideration just what the limits of building should be as correlated to the limiting of the size of the maximum load, width of vehicle, pressure per inch width of tire and speed of the motor vehicle. The necessity of this study is fully emphasized by the ever increasing cost of construction and maintenance and by the serious break-ups as summarized previously.

The fifth conclusion was that it is absolutely necessary to build better and more permanent types of pavement. We have already shown the large proportionate break-ups in our pavements due to bad drainage and increased traffic density. Maintenance per mile per year in New York State costs from $100 to $1000, depending upon the type of pavement used and the factors already considered. It is my opinion from our experience that all through route pavements should have a concrete base, that is if we are looking for dollar economy and the uninterrupted use of our pavements for the greater part of the time. Each repair in itself takes money, and more money is lost commercially by the people along the road as well as by the tourists when everyone has to go by a long detour.

Excessive Loads Ruin Best Construction

My sixth conclusion was that we must limit the size of the maximum load and place some regulation upon motor-truck traffic.

We have already seen the damage done by the increased traffic in the spring break-ups and in shortening the average life of our semi-durable pavements while increasing the cost of their maintenance.

Curves have been plotted for highways in different sections of the state. From these it appears that, for ordinary waterbound and bituminous roads, an average maintenance charge of about $500 to $700 per mile per year will keep them in satisfactory condition indefinitely, or so long as the traffic tonnage per day keeps around the 1200 mark. As an example of this let me say that we have in our state waterbound macadam 14 years old still in good condition. But as this mark is exceeded there seems to be immediate need for reconstruction. It is probable that this increase in tonnage occurs mainly through the increased use of motor trucks.

Means must be found whereby we can build roads up to such standards as will meet a certain class of loading and then legislative restriction must place such limits on unreasonable traffic that it will be prevented from negating the benefit taxpayers ought to receive from the construction of good roads. It will be well to remember that legislation should not be so drastic as to retard the development of economic transportation.

The seventh conclusion was that additional factors of safety should be employed as part of a general system of social economy. Hard and durable shoulders should be provided for safety so that when fast moving traffic is forced upon them there will be no skidding or accidents. The increased traffic at high speed calls more than ever for this safeguard.

Curves should be banked for safety. This refinement has been objected to in that it encourages fast travel. But speed has come to stay, and why not provide for those who, driving under strange conditions, need all the safeguards they can have? Widening the pavement proper has decreased accidents on sharp turns. Some curves have been made 24 to 28 ft. wide where the regular surfacing is only 16 ft. in width.

Approaches to bridges, to grade crossings and at intersections should be safeguarded. Many serious and fatal accidents have been caused by approaches to intersections and grade crossings being on a grade and without proper sight distance. If the grade crossing of a railroad is above the roadway proper, it is safer if the roadway be carried out level 25 ft. or more on each side of the track so that it may not be necessary to change gears in driving across. This is also applicable to approaches to bridges, which should have a level stretch, as long as is economically possible, before passing on to the bridge floor.

Street intersections also should be approached as nearly on the level as possible and greater safety may be secured by cutting the corners to a longer radius so that cars turning sharp corners will be able to keep on their own side of the street until the full turn is made. Danger signs should be visible night and day. To accomplish their purpose and not be in themselves a danger, they should be placed at a standard distance from the conditions to which they call attention.

One would have little doubt that the above safeguards are necessary if he were to investigate just a few of the causes of the many accidents. The extra cost will be far more than compensated for by the additional safety to life and limb.

Maintenance Under Separate Department

My eighth conclusion was that an adequate scheme should be developed for maintenance, renewal and reconstruction from the day of completion on. A pavement begins to wear out the hour it is put into service and in order to perform its full function and justify its original cost, maintenance must be continuous. That this work should be well done, continuously, requires a stable organization charged with this sole duty.

I have called attention previously to the average age of waterbound macadam and bituminous macadam, penetration method, and their cost of maintenance. The curves shown in the illustration give the relation of maintenance to tonnage. Unfortunately the construction of the more durable types has been so recent that a comparative study on the same basis as the waterbound and bituminous macadam is practically impossible. The records to the present time, seem to show that these durable types are fully adequate to the demands made upon them. And in most cases $100 and up per mile per year is sufficient allowance for maintenance—most of this being directly chargeable to items other than pavement. This, however, will change in the next few years as the pavements begin to require patching.

I would like to call attention to the fact that auto registrations are increasing more rapidly than new construction, although the traffic tonnage does not increase in proportion. That is to say, up to 1916 at least the large increase was in passenger cars. Another point is the fact that the yearly maintenance does not increase as rapidly as construction, due probably to two conditions; first, increased quality of the original construction and the building of more durable types of road; second, increased efficiency in the maintenance

department. It is also evident from the curve that the tonnage follows parallel with the average maintenance curve, indicating a direct relation between traffic and maintenance.

The ninth conclusion was that laboratory control is cheap insurance for the success of road construction.

In 1916 the total cost of testing 4137 samples of all kinds was $40,268.71, while in 1917 the cost of testing 3645 samples of all kinds was $37,687.07. This stated in percentage would make the cost 0.4 of 1% in 1916, for $9,878,165.27 worth of construction and maintenance work, and 0.37 of 1% in 1917 for $10,262,309.52 worth of construction and maintenance. Could you have much cheaper insurance when you consider that this covers all material surveys, all testing, experimental and research work?

To be able to get durable types of pavement at reasonable cost we must know all the characteristics of the material we intend to use, whether we import or manufacture it. Many times in our experience tests have developed materials right alongside the work that were equal to, and in some cases better than, the more expensive imported materials which in these days of car shortage it is sometimes impossible to get. Thousands of dollars have been saved by such investigations.

Work Depends on Proper Tests

Certain kinds of materials are specified for certain classes of work. The success or failure of the work from day to day depends upon that material being up to the specifications. Everyone knows that the proper proportions and manner of mixing make great differences in the finished result, and here again the laboratory makes for safety.

The men in charge of work should make field tests in a practical manner and in parallel with those of the laboratory in order that a constant check may be kept upon the materials going into the work.

I can understand that, merely as a matter of cost, it may not be practicable for every department in the early stages of its development to have a fully equipped laboratory, but if there is a sufficient demand for laboratory work to guarantee enough of it, the commercial laboratories in existence would, I am sure, be willing to equip themselves to render this service at a nominal charge. It is also a field in which universities with the proper equipment can render great service. The importance of testing has been passed over too lightly. Judgment must be based upon scientific determinations.

The tenth conclusion was, there are many opportunities for the highly trained engineer in highway work. The problems of design, drainage, maximum grade, alignment, traffic studies, efficient cost per ton mile, dollar economy in the use of materials and construction methods, experimentation, laboratory control, testing of materials, etc., offer him a large field for his talents and energies. He will learn what is meant by factors of safety (rather factors of ignorance according to one highway commissioner) and to what degree they enter highway engineering problems. The public will demand better and more economical results, which can be obtained only by trained men with experience who can apply theoretical formulae to their problems. When to technical ability a man adds executive skill and the ability to organize and direct other men, he may hope to benefit the highway profession as much as it is certain to benefit him.

Engineers Find Site for Cantonment in Porto Rico Ideal

WORK on the cantonment at San Juan, Porto Rico, was started early in February. Charles B. Burdick, of Alvord & Burdick, consulting engineers, Chicago, supervising engineer for the work, writes of the site as follows:

"This is the finest climate in the world. It has California skinned forty ways. Day and night the temperature ranges from 70° to 80° F., and always a fine breeze (the southeast trade) blowing in the same direction. We have 70 to 80 in. of rain, all falling in hard showers lasting only a few minutes at a time. It has rained hard every night, but has caught the boys only once in the day. All told, I don't think we have lost half an hour on account of rain. The soil is about as sandy as Saugatuck, and we have absolutely no mud and no dust.

"Naturally, this island has everything. The shores are high (100 to 200 ft.), with a background of mountain (3500 ft.) 10 to 20 miles inland, always in plain view. Our camp is shaded by probably 10,000 cocoanut palms, most of which we shall have to locate to squeeze in our buildings and tanks.

"Our office and bunks are in the yellow fever barracks, Spanish buildings with thick stone walls, brick roofs and high ceilings. There is practically no glass on the island except in the downtown stores. All openings are latticed with shutters, which we keep partly closed on the windward side of the buildings so our papers will not blow away. There are no screens, few flies and mosquitoes, but we sleep under bed screens to keep out what few there are. Casa Blanca, where the commanding General lives, was begun by Ponce de Leon about 1520, and the old Spanish forts and the city walls are only a little less ancient.

"The city is very clean, paved mostly with asphalt, nearly all sewered, and supplied with a filtered surface water supply. The plant was completed last year (Roberts pressure filters). The roads are administered under the insular government, and there are now something over 200 miles, all water-bound macadam and all oiled, adjacent to San Juan. We have a boulevard extending for many miles beyond the camp."

Has Right to See City Engineer's Records

The right of the San Francisco Bureau of Governmental Research to see the plans and records in the city engineer's office pertaining to the city's Hetch Hetchy water-supply project has been upheld by the Superior Court in a decision which declares that any citizen is entitled, under the city charter, to inspect "all books and records of every" city office or department. The decision was printed in *The City* (No. 12; February, 1918), a publication issued by the bureau named. The preceding number dealt with the case prior to the rendering of the decision.

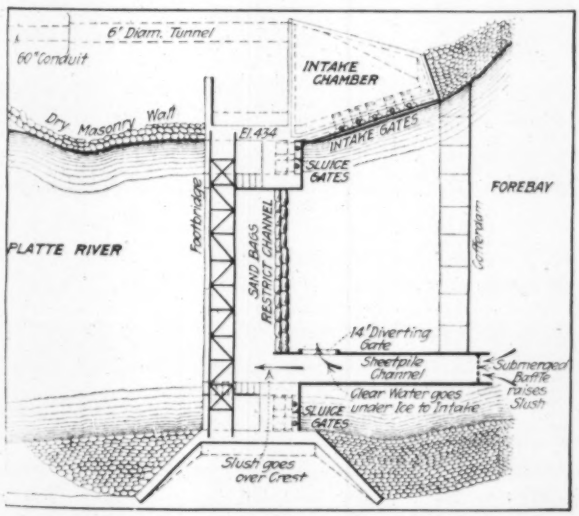
Sheet Piling Channel in Forebay Eliminates Slush Ice

Steady Flow of Water Chilled in Rocky Canyon Is Maintained in 60-In. Conduit in Coldest Colorado Weather

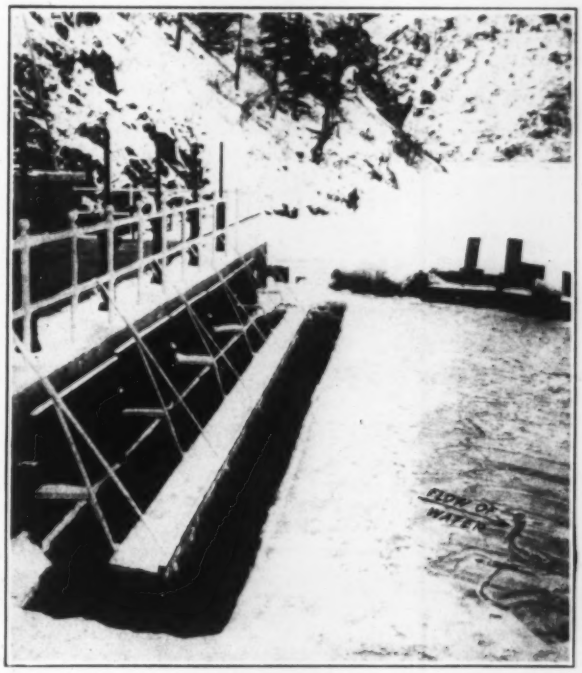
BY CONFINING the thread of the stream to a well defined channel through the forebay feeding the headgates of the Platte Cañon intake of the Denver Union Water Co., slush ice difficulties were largely overcome the past season. A channel of sheet piling directs the current toward one end of the dam over which the slush ice flows while the clear water underneath is diverted parallel to the dam under the solid ice to the intake gates.

More than the usual amount of slush ice comes to these headgates because of the following peculiar conditions. The south fork of the South Platte River, flowing into Lake Cheesman, a 26,000,000,000-gal. storage reservoir, undergoes a gradual modification in temperature. The run-off from slowly melting snows in the upper reaches of the watershed comes, under the tempering influence of a quiescent body of water of great depth and volume, to acquire the warmer temperature of the mass. Leaving the outlet at Lake Cheesman the comparatively warm water rushes at once into a rugged, boulder-strewn channel, where it is dashed into spray and churned among the ice-covered rocks. The temperature of the effluent water is thus suddenly lowered by aëration and contact with congealing surfaces, the result being that at the season of maximum transition (occurring with the first extreme cold and before the temperature of the lake has felt the winter's effect) slush ice is formed in great quantity. The slush runs less heavily as the winter progresses and the temperature of the impounded water approaches that of the environment into which it is discharged.

About 25 miles below Lake Cheesman is located the intake of the 60-in. conduit through which the water diverted from the South Platte is delivered to the different sedimentation and filtration units preparatory to domestic consumption in Denver. The problem of dealing



DIVERSION CHANNEL BYPASSES SLUSH ICE



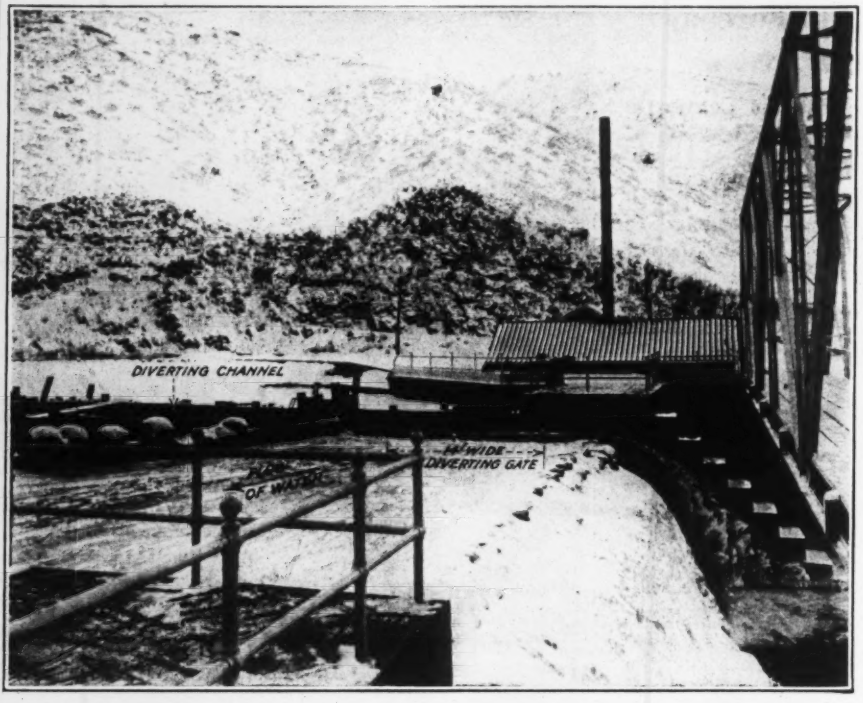
ICE IS NOT PERMITTED TO FORM DIRECTLY IN FRONT OF INTAKE SCREENS

with slush at this intake has been an evolutionary one. (See *Engineering Record*, Oct. 19, 1912, p. 424.) In order to make clear the method finally adopted, and upon the principle of which it is proposed to build permanent adjuncts to the present dam and intake structures, it will be sufficient for the purpose of this article to describe the improvised but effectual method now in use.

Reaching the head of the forebay above the intake the progress of the slush is temporarily retarded by the effect of still water. Gradually accumulating and opposing the current, it finally succumbs to the pressure from upstream and comes down upon the dam. This moment of sudden approach is anticipated, the terminal valves on the 60-in. conduit are closed to permit mere circulation and the intake gates are lowered correspondingly in order to minimize the quantity of slush drawn into the intake chamber from the mass, which in a surprisingly short time is packed into the angle between dam and intake and into every other cubic foot of forebay as well. To get the water through this mass of slush without drawing more than is caused by "tunnelling out" a by-pass from the river channel to the gates is the problem.

Before this tunnelling is attempted, a means must be provided for dealing with the running slush which is encountered as soon as the current is located and tapped. This has been found in the form of sheet-piling channels. The driving of piling by hand is contingent upon the formation of ice upon which to stand while driving. This condition does not always precede the slush. Moreover, it takes valuable time to drive piling—valuabe in that the reserve supply for the filter plants in the sedimentation basis is being continually drawn upon.

Starting at the upstream corner of the intake chamber, a line of piling making a cofferdam is driven parallel with the crest of the dam to a point opposite the



SACKS ON DAM-CREST CONFINE CURRENT AT END OF DAM

Boiler plant at end of footbridge furnishes steam to coils suspended in intake chamber to prevent slush ice from solidifying.

near end of the improvised 10-ft. spillway, formed by placing sacks of sand on the remainder of the dam-crest. Butting against the end of this wall another is started at right angles to the dam, extending to within 14 ft. of the dam-crest downstream, and upstream about 25 ft. Between the downstream end of this wall and the dam is constructed a diverting gate, which now constitutes the only opening through which slush may find access to the intake chamber. This gate is formed by a cut-off with one end notched to fit snugly over the sloping crest of the dam. It is of sufficient depth to bring its bottom 6 ft. below the ice surface when the top is level with the crest, thus leaving a clear opening 14 ft. wide and a depth below the cut-off varying with the sand on the river bottom, but averaging about 6 ft. Through this gate the water is drawn as soon as the intake gates are opened.

A channel is then sawed through the ice upstream until the location of the current is determined by soundings. The slush under this ice is cut out for only 3 or 4 ft. in depth until the current is encountered. It is then churned loose to the river bottom. It is generally necessary to drive additional piling to divert and raise the current into this new channel, its tendency frequently being to cross the latter at an undesirable angle, which would cause the current to reënter the new channel only after encountering the main piling-wall below, too close to the diverting gate. By raising the current farther upstream it runs smoothly by the time it reaches the diverting gate, the slush being borne on its surface. Should the cross-current enter the new channel near the point of suction it would agitate and submerge much of the slush, which would then be drawn into the intake. The first 25 ft. of this new channel above the dam is then made safe from danger of cross-currents from either direction by an additional line of piling driven on the opposite side, thus forming a sort of flume at the approach to the diverting gate. There is now no possible course for the slush to follow save down this flume. The final step is the submerging of a second cutoff near the upstream end of this flume. Its top is approximately 4 ft. below the water surface, its bottom rests on the river bed, and its function is to cause an upthrust of the current which will prevent the channel from clogging with slush as the result of a sudden falling off in the river flow, frequently caused by jams upstream.

The slush, thus compelled to run on the surface, confined to a designated path instead of approaching the point of suction from any or all directions, and with danger of sudden stoppage in flow overcome, has but little choice on reaching the diverting gate, where the cutoff (assisted by the current's acceleration toward the dam) literally thrusts the slush over the dam, drawing clear water from underneath. The proportion of the river which may be diverted in this way without drawing slush is limited by that amount which is required to keep slush on the move over the dam, an amount which itself varies with the ratio of slush to water. Under average conditions two-thirds of the river can be effectually diverted, and even with a very low river and heavy run of slush never less than 50% of the total has been taken into the 60-in. line, practically free of slush.

The fight with slush ice is in the hands of A. Q. Rowell, superintendent in charge of the 60-in. conduit and filter beds at Platte Cañon, working under the direct supervision of D. G. Thomas, chief engineer, Denver Union Water Co.

Concrete for Light Vehicles—Macadam for Heavier Traffic

The City of Wellington, New Zealand, has authorized the issuance of bonds to the value of $145,995 for the construction of about six miles of concrete road 25 ft. in width. This roadway will connect Wellington with Petone, one of its suburbs. The concrete strip will be laid at the center of an existing 100-ft. macadam road and will be used only for the lighter traffic, such as carriages and light carts, motor cars and motor trucks. All heavier traffic must keep on the macadam road.

Motor Trucks for Snow Removal Superior to Teams

At Meeting of Western Society of Engineers City and Park Officials of Chicago Discuss Various Measures Used

MOTOR trucks, hauling as much snow as five teams, are preferable to the latter for every reason that enters into the prompt and economical removal of snow from the downtown district of Chicago. This was the conclusion stated by W. J. Galligan, assistant superintendent of streets in charge of street and alley cleaning, at a recent meeting of the Western Society of Engineers, where a symposium on "Snow Removal" was participated in by city and park officials. Large slip scrapers, ordinarily used by the Lincoln Park Board only for cleaning skating ponds, proved efficient for boulevard work where the haul was short. The South Park Board officials showed photographs of a hastily-developed rotary plow and loader attached to the front of a three-wheel motor. The snowfalls of January and February, 42.5 and 8.4 in. respectively, were of such frequency and intensity that all usual methods of attack and removal were inadequate. Some of the methods used by the city and park boards as told of at this meeting are given below.

City Hires 66 Trucks

The work of snow removal in the Loop, according to Mr. Galligan, is carried on from the first ward yard situated at the foot of Randolph St. just east of Michigan Ave. Here the emergency forces gather, are made up into gangs and are sent out. The quarters are inadequate for the orderly assembly and sending out of such forces, it being necessary on many occasions to secure the services of two mounted policemen as well as four or five officers on foot to keep even a semblance of order and to prevent the mob from breaking down the doors.

Numbered snow time-cards are issued bearing the name and address of the holder. These cards are taken up when the men are sent out, and are returned to them when they come in. A list of these card numbers is furnished to each gang foreman, and in that way he is enabled to check his gang several times during the working period, a process found very necessary.

The teams and trucks are handled in much the same way. The team tickets bear the name and address of the holder and contain numbered marginal spaces for punching the number of loads hauled, a space being punched when the load leaves the street and again when it is unloaded at the dump. Tickets are made up in two colors, one for day and one for night.

As the city budget did not carry a provision for the employment of motor trucks in this work, consent was obtained from the City Council to use them and the rate fixed at $25 for a nine-hour day. Only dump trucks of large capacity were used. They were made up into squads of ten each. Each squad was in charge of a ward superintendent, a card puncher and two sub-foremen. Five loaders were assigned to each truck. In that way trucks were loaded quickly and kept moving, and by working day and night shifts the principal streets in the Loop were cleaned in 72 hours. For the reason that transportation lines were scouring the haunts of labor, bidding as high as $1 per hour and meals, and because of the extremely cold weather, it was difficult to keep men, and in order to compete somewhat with the other agencies that were bidding frantically for help, the city picked out the likely looking men, kept them for the night forces and paid them time and a half, or $3.97 for eight hours. In addition, on the coldest nights hot coffee and sandwiches were sent to the gangs under the direction of a hastily-organized commissary department. How much this service was appreciated is shown by the fact that on two occasions gangs that had been in some way overlooked by the coffee truck brought their tools to the ward yard at midnight, refusing to continue work.

The employment of motor trucks in the work of snow removal has shown to the officials of the bureau of streets that the results obtained by their use is far superior to that of teams. The large amount of creosote block pavement in the Loop made the handling of teams extremely difficult. Unskilled drivers and poorly shod horses made the task very hard and as a consequence traffic was constantly interrupted. Fifty teams poorly handled at strategic points in the Loop will tie up Chicago's street car traffic in five minutes in a way that may take hours to untangle. With motor trucks no such situations were encountered. The limited number of dumping spaces handy to the Loop is also a strong factor in favor of the employment of motor trucks. The Graham & Morton dock at the foot of Wabash Ave. is the largest Loop dump, and will accommodate about 75 teams. At the height of a snow-dumping day or night this spot was a bedlam of yelling, cursing drivers with the work being interrupted often by staggering and falling horses. It also was necessary to shovel the snow from the tail end of the wagon into the river, while bottom dump wagons deposited their loads on the dock, making it necessary to rehandle it into the river. One motor truck will haul as much snow as five teams, and inasmuch as 66 trucks, equivalent to 330 teams, used the Graham & Morton dock in one night, the increased capacity of the dock by the use of motor trucks is obvious. The 66 motor trucks came in and out of the dump without a minute's confusion or delay.

The rapidity with which the motor trucks operated is indicated by the record of Jan. 29, a typical night at the Graham & Morton dock, when 680 loads of snow were dumped in the river by trucks in 480 min., an average of one load every 45 sec. for eight consecutive hours.

During the blizzards of Jan. 6 and 12 the department hauled out of the Loop 14,611 wagonloads of snow, or 67,202 cu.yd., together with 5644 motor truckloads containing 44,179 cu.yd. The cost averaged 54c. per cubic yard.

Lincoln Park Uses Ice Scrapers

In Lincoln Park, according to G. T. Donoghue, the experience has been that the horse plow should be pulled and the motor-driven plow pushed. In the former case the abrasive action of the horses' hoofs helps to loosen and break up the snow, while in the latter case the snow is pushed to one side before the wheels can pass over

and pack it down. The motor-driven plow is by far the more efficient if it can be used before the snow is packed. After packing has taken place the motor-driven plow has a tendency to ride over the packed portions.

In the January storm there was no chance to keep ahead of the snow. Motor-driven plows sent out on the boulevards got stuck in the drifts and had to be hauled out with teams. Where 6- and 7-ft. cuts are met they are out of the range of ordinary plow and scraper work. A steam shovel or dragline would be a more appropriate piece of machinery. As the plows went out of commission, hand shoveling was the only resort left to open up the pioneer cut. In some cases the snow was cast aside, in others loaded directly into wagons. A piece of equipment that is ordinarily used only when cleaning the skating ponds was then brought into service on the boulevards. It is a form of slip scraper of ½-yd capacity, made of wood and shod with iron. The snow was gathered from the boulevards, hauled a short distance, and then dumped clear of the road. For the park problem this scraper was very efficient. Following the slip scrapers there was used a battery of from three to five horse-drawn blade scrapers that pushed the snow toward the curb. Where it was possible these scrapers straddled the windrow left by the machine ahead. After the horse-drawn scrapers had done their work the motor-driven plows followed them and made the finished cut. The outlined procedure was the one usually followed. In many cases it had to be altered to fit special conditions. The outstanding feature in handling the February snowstorm was that it was necessary to reverse the usual method of procedure, sending the plows over last instead of first, and using the shovelers to open the path instead of trimming up after the path had been opened by the plows.

South Park Experiments with Plows

The ordinary procedure followed by the South Park Board, said Harry Richards, is as follows: "When a fall of snow was 4 in. or less, we sent out 10 plows—five left-hand and five right-hand—on a 50-ft. driveway, the idea being to bring all of the snow from the center of a drive to the gutters. When a snowfall was more than 4 in. and less than 8 in., we started one of the plows drawn by four horses near the gutter to throw the first cut of snow on to the planting space or edge of the sidewalk, then followed with four other plows working from the center to the gutter.

"Later the plan of plowing the snow from the gutters to the center of a drive was adopted, but there were several reasons why we abandoned this method of snow cleaning. One was that because of the automobiles, milk wagons and other vehicles standing along the curbs it was impossible to get the snow cleaned along the gutters. Another was because when the ridge of snow in the center of the street began melting, the water ran toward the gutters, sometimes freezing before reaching them and thereby coating the drive surfaces with ice which made it quite dangerous for traveling. A third was that it was ever so much harder work for the teams to plow uphill from the gutter to the crown of the drive.

"All of the special motor snow-plows of the South Park commissioners, those equipped with V-shaped plows, from which we could usually expect fairly rapid and efficient service in ordinary snowfalls, met their Waterloo in these January storms, became stalled in the drifts and were compelled to give up the battle. Straight moldboard plow attachments on motor trucks proved no better. This left us with slowly-drawn plows of the road-grader type as our only means (aside from hand shovel work) of opening passageways through the tightly-packed and badly-drifted snow. The areas covered by the park commissioners in their snow cleaning work include about 67 miles of drive, 175 miles of walk and from 90 to 95 acres of skating ice.

It was a frequent occurrence to be obliged to dig the horses out of the drifts in which they became stalled. Progress could only be made by using four horses on a grader and at first we found 14 such grader outfits necessary to open a passageway through the drifts along the boulevard wide enough after one trip to permit an automobile to make its way through. These 14 plows were so set that the blades cut through the snow at a sharp angle, each plow opening as narrow a cut as possible, and even then seven graders were sent ahead to break a way through and scrape some snow off the top, which the seven following behind opened down to the pavement. Later when more headway had been made, these narrow passageways through drifts were widened by hand shoveling to allow two machines to pass."

Suggests Coöperative Experiments

While no doubt a machine can be designed whose operation will be elastic enough to handle satisfactorily the different kinds of snow encountered in a season, in Mr. Richard's opinion a great deal of experimentation will be necessary under actual working conditions to evolve snow-handling equipment that will prove reasonably satisfactory for the varying requirements of this line of work. Such undertakings must be thoroughly and scientifically gone into and worked out and will necessarily demand the expenditure of considerable money, probably more than any one particular concern would be willing to pay. It is hoped that some coöperative plan can be brought about whereby large cities and municipalities interested may pool their interests and contribute proportionally to a fund to be used in arriving at a practical solution of the perplexing problems of snow-removal work in cities. In some such way the burden of cost can be distributed so it will not become too oppressive to any one concerned, and experts can be secured to devote sufficient time and ability to the work to master its problems and produce results that will be welcomed by those in charge of snow-cleaning work in our cities and by the public in general.

Costs of snow-cleaning work outside of the downtown district range from $8.31 per mile as a minimum for a 4-in. snowfall to $14.98 per mile as a maximum for a 6-in. snowfall, two teams being used to a grader. These costs are based on a rate of $6 per eight-hour day for a team and driver and cover only the "roughage."

Three winters ago a snow-slushing machine was constructed for disposing of snow in the downtown district through the sewers instead of loading it on wagons and

trucks and hauling it to a dump. This was a small machine, consisting of a water turbine with a supply line to a fire-plug, so patterned that it would hang in a sewer manhole in a wire mesh basket, three free blades chopping the snow and the water from the turbine exhaust forcing or washing it through the wire basket into the sewer, where the current of water and sewage took it away.

In January of this year the abnormal snowfall plainly showed the necessity of a powerful and efficient machine to handle snow rapidly and in large quantities. After a little experimental work a two-disk rotary snow-plow was constructed and given some preliminary tests, but the lateness of the season did not permit perfecting it. With more power, however, it gives promise of being developed into a practical affair.

A mechanical loader is being sought by A. C. Schrader of the West Park Board. He exhibited a suggestion, but none of the mechanical details had been worked out. It consists of two inclined conveyors, one operating parallel with the direction of travel of the machine and lifting the snow from the pavement and depositing it upon a conveyor operating at right angles to the direction of travel and delivering the snow in high windrows or loading it into wagons traveling alongside.

Bridge Collapse Ascribed to Earth Subsidence

Sudden Failure of Concrete Slab Spans Near Cement Plant Wrecked Two Years Ago by Large Landslip

By E. J. Doyle
Consulting Engineer, Albany, N. Y.

During the night of Feb. 26 a portion of a reinforced-concrete road bridge across Claverack Creek at Hudson, N. Y., sank into the water. The failure was sudden. A heavy loaded truck had just passed over the bridge; the driver of the truck noticed nothing to indicate failure, but an automobile which met the truck a hundred yards from the bridge plunged into the gap left by the spans which had failed.

The bridge, built about eight years ago, was of the slab type and consisted of eight 30-ft. spans. The slabs were supported on concrete bents carried on pile foundations. Two spans at one end of the crossing failed. The others remained intact, except that some settlement over the whole length of the bridge is apparent.

The failure is of added interest because of the nature of the ground in the vicinity of the wrecked bridge. On the morning of Aug. 2, 1915, a large portion of the plant of the Knickerbocker Cement Co., located on the bank of the stream about a hundred yards downstream from the bridge, collapsed and sank into the ground, leaving only the top of a tall chimney and some wreckage of steel trusses in sight (see *Engineering Record*, Aug. 7, 1915, p. 197 and Aug. 18, 1915, p. 253; and *Engineering News*, Aug. 12, 1915, p. 330). The collapse of the cement plant was so sudden that five men who were working in the boiler house were caught and buried in the wreckage.

At the time of the cement-plant failure the bed of the stream bulged up several feet and discharged the water from the creek over the flat lands on each side. The bridge was nearly covered with water, but sustained no apparent injury. The state geologist later made a study of the soil formation in the vicinity. There is a surface layer of cemented sand and gravel from seven to twenty feet thick, and under this is found very soft, wet, unstable clay, of a thickness of from 100 to 120 ft. The surface layer of gravel is stratified at a steep angle. Some narrow fissures exist between the layers of gravel, but as a whole the ground is hard and compact and was believed to be capable of safely taking the loads that were put upon it.

The exact cause of the bridge failure cannot be determined at present because of the unusual depth of the water, but from a review of the causes of the cement-plant failure and from indications of the bridge collapse it seems apparent that it was due to a sliding of the stratified gravel upon itself, which carried a portion of the bridge down with it. The ruptured concrete shows a clean break, and a portion of one slab which remains above water level does not appear to have suffered greatly, although some cracks appear on the surface.

Special Water Rate for Home Gardens

To encourage home gardening the city authorities of Corpus Christi, Tex., have offered a water rate of $1 for the first 2500 gal. and 15c. per 1000 gal. for all above that amount, for the season of 1918. This is said to be only slightly above the cost of pumping. Those desiring the special rate must sign an agreement to plant and care for home gardens. Frequent inspections will be made to see that the privilege is not being abused.

FAILURE OF PIER WRECKS TWO SPANS OF CLAVERACK CREEK BRIDGE ADJOINING CLAY TERRACE WHOSE SUBSIDENCE DESTROYED PORTLAND CEMENT PLANT

Pennsylvania Water Rate Decision Covers Many Points

Public Service Commission Supreme in Matters of Judgment—Ground Water, Parallel Mains, Going Value Bond Discount, Reproduction and Book Costs Involved—Municipalities Win in Ohio Valley Water Co. Suit

By Farley Gannett
of Gannett, Seelye & Fleming, Engineers, Harrisburg, Pa.

THE Supreme Court of Pennsylvania has upheld the Public Service Commission and reversed the Superior Court in the Ohio Valley Water Co. rate case. This is the most important water rate case in Pennsylvania, as it involves the rates for service to a large group of communities near Pittsburgh and definitely settles Pennsylvania public-utility law and practice on several very important and much-mooted points. Probably the most important point settled is that the decisions of the Public Service Commission are final in all matters of judgment based on facts brought out by evidence. In other words, the judgment of the courts cannot be substituted for that of the Public Service Commission.

Seven Main Points at Issue

The case at issue was tried before the Public Service Commission during the summer and fall of 1915; the commission's decision was made public in February, 1917; the Superior Court, to which both sides appealed, handed down its decision in the summer of 1917, the case was argued before the Supreme Court in January, 1918, and its opinion was handed down on Feb. 25, 1918.

The details of the reproduction valuation were very largely agreed upon by engineers representing the two sides so that only certain points in controversy, on which they did not agree, were presented to the commission in the form of controverting testimony. These points were:

(1) The value of real estate on which two distributing reservoirs were located. (2) The value of real estate upon which the pumping station and drilled wells were constructed. This involved the value of an underground water-supply. (3) The value of the piping system in one borough, formerly owned by a competing water company, but paralleled by the Ohio Valley Water Co. with new mains before the old lines were purchased by the Ohio Valley Water Co. (4) Going value. (5) Bond discount. (6) The weight to be given, in arriving at fair value, to reproduction cost and book cost. (7) The question was also raised as to the propriety of a Public Service Commission composed of lawyers changing the period during which it was agreed by the engineers that the plant would be under construction. This question arose in the determination of the amount of interest during construction in the reproduction cost.

The Public Service Commission decided all of these points quite closely in accordance with the claims of the municipalities, giving a fair value of $935,000. The Superior Court revised many of the findings of the commission, its conclusions resulting in a value of about $1,300,000, and the Supreme Court in turn has now reversed the Superior Court and upheld the commission on all of these points.

The Supreme Court held that the Superior Court could not change conclusions as to value reached by the commission so long as the commission's conclusions were not contrary to the evidence. The Superior Court, in its revisal of the Public Service Commission, had ordered the commission to increase by about 100% its allowance for real estate at the pumping station, a matter of $50,000; ordered an increase of 200% in the amount allowed by the commission for parallel pipe lines, amounting to nearly $60,000; ordered the commission to give a going value of about $200,000 where the commission had made no specific allowance under this item, and ordered the commission to make allowance for brokerage on bonds of over $75,000 where the commission had allowed none. With respect to these various points the Supreme Court went into considerable detail in discussing its reasons why the commission's figures should not be changed, the position of the Supreme Court being that there was sufficient evidence to warrant the commission's conclusions in each case.

Real Estate and Underground Water-Supply

The Ohio Valley Water Co. gets its water from a large number of drilled wells about 35 ft. deep, under the bed of the Ohio River at the upstream end of Neville Island. This land cost the company $3900 in 1904; its present value was placed by witnesses at about $8000 for ordinary manufacturing purposes, while the commission, considering the underground water, placed its value to the water company at $48,800. The Superior Court ordered that its value should have been fixed at about $100,000.

The Supreme Court states that the Superior Court probably considered that the sand bar through which the wells were drilled acted as a filter and purified the river water, but the Supreme Court says further that the evidence was strong to show that the water tapped by these wells was ground water which underlies the whole river bed and is tapped by wells throughout this whole region and that there is no peculiar value to the wells at that particular point. The Supreme Court said that the commission might, from the evidence, have been warranted in finding that the sand bar on which the water company located its wells has no special value as a source of water-supply over other land in the vicinity.

Parallel Pipe Lines

In the borough of McKees Rocks the Monongahela Water Co. at one time supplied raw Ohio River water. Later, the Ohio Valley Water Co. entered the borough and paralleled its lines in competition and having a clear and purer water, took away much of the Monongahela Water Co.'s business and finally bought it out. The Ohio Valley Water Co. thus had two systems of pipe lines in the borough. Much evidence was introduced to

show how this situation was brought about, how much or how little the old Monongahela Water Co. lines were now used and as to the adequacy of the Ohio Valley lines to supply the borough.

The commission allowed one-third of the engineers' estimate of the value of the Monongahela lines, on the basis that only one-third of their capacity was useful or would be in a reasonable time. The Superior Court directed the commission to allow full value for these Monongahela lines. The Supreme Court says that the purchase of these lines was purely to prevent competition, and the determination of what was necessary and what was overdevelopment under the circumstances was clearly within the proper function of the commission and their finding should not be disturbed so long as this finding was sustained, as it was in this case, by competent evidence.

Going Value

The commission made no specific allowance for going value but stated that this item had been given consideration in arriving at fair value. The Superior Court said the commission should have made a specific allowance of about $200,000, being the lowest estimate of the water company's witnesses on this point. The Supreme Court says that the commission had evidently made some allowance for this item. As this is a most important point the Supreme Court's words concerning its view of going value are quoted:

Another question as to which the Superior Court differed from the judgment of the commission was as to the method of making allowance for what is known as "going concern value." The Superior Court held that this value should have been estimated as a separate item, and that the lowest amount named by the witnesses for the company would not be excessive for this item. One of the witnesses estimated the "going value" in a lump sum of $225,000, and another placed it at $185,000. Neither of them gave any convincing reason for naming these particular amounts. Mr. Chester, one of the witnesses for the company, defined "going value" as the difference between what he termed the bare bones of the plant and those bones are developed into a prosperous and growing business. In other words, he regarded it as the cost of attaching the business to the plant. The record shows, however, that in making its estimate the commission in no sense confined itself to the bare bones of the plant. On the contrary, it took it as fully clothed with all the attributes of an established business. In arriving at its estimate of the value of the property the commission considered it as a going, operating concern, rendering successful service to the community and being well patronized. It found that the properties cost $841,343, which, after deducting accrued depreciation, gave a present value by this method of $783,194, and upon this the commission placed a fair value for rate-making purposes of $924,744, or an increase of $141,550 over what it found to be the present actual value. In arriving at this last figure the commission took into consideration the conditions existing at the time the company was started, as well as at the present time, noting the difference in population, cost of materials, etc. It endeavored to arrive at an amount which, under all the circumstances, was a fair basis for determining the reasonableness of the rates charged. No definite amount was put down as representing "going cost," but that element was taken into consideration in arriving at the fair value. The mere physical value of such a plant, considered apart from the fact that it is a going concern, would be only its scrap value. So that when a proper allowance is made for the value of the physical property from an investment standpoint, with the business attached, the going concern value is necessarily included within that estimate. This question of an allowance for going value has nowhere been more carefully dealt with than by the Wisconsin Commission. The Supreme Court of Wisconsin in Appleton Water-Works Co. vs. Commission, 154 Wisconsin, 121, said (p. 148): "The fundamental difficulty with the attempt to set a definite sum as the measure of going value is that it is an attempt to divide a thing which is in its nature practically indivisible. The value of the plant and business is an indivisible gross amount. It is not obtained by adding up a number of separate items, but by taking a comprehensive view of each and all of the elements of property, tangible and intangible, including property rights, and considering them all not as a separate thing, but as inseparable parts of one harmonious entity and exercising the judgment as to the value of that entity. In this way the going value goes into final result, but it would be difficult for even an expert to say how many dollars of the result represent it." Our own case of Turtle Creek Borough vs. Water Co., 243 Pa., 401, is authority for the proposition that in a rate case it is not necessary to fix a separate and distinct sum for going value. It was there said (p. 413): "As to the items of going value, interest during the period of construction, and the cost of repairing the streets, which appellant contends were not allowed, or at least that there were no distinct findings as to those items, we agree that these were elements to be considered in arriving at a just valuation of the properties, but we cannot agree that it was the duty of the court to set out in its findings each separate item of value and make the sum total of the separate items the final conclusion of the court as to the valuation of the entire plant. In the opinion of the court en banc on the exceptions to findings of fact and conclusions of law, it is stated that these items were not eliminated by the trial judge in fixing the valuation, but that they were given due consideration. It is further stated that the trial judge did consider going value as an element in fixing the value of the plant as a whole."

No claim is made by the company for deferred dividends, to which the stockholders were reasonably entitled. In fact, it does not appear from the record that any money was put into the business by the stockholders. The record seems to indicate that all the property now owned by the company has been procured by the issue of bonds or from income derived from operation. We do not find from the record that the commission in estimating the fair value of the property failed to take into consideration the element of value arising from the fact that the plant of the company is that of a going concern with an established business.

Brokerage

The commission allowed no item for brokerage; the Superior Court said the commission should have allowed 7½%. The Supreme Court says that in so far as the company apparently spent no money for brokerage, bonds were very largely issued in exchange for various properties going to make up the consolidation of water companies and were issued considerably in excess of the real value of the properties taken over, no item for brokerage should be included in the valuation.

In conclusion the Supreme Court says:

The ascertainment of the fair value of the property for rate-making purposes is not a matter of formulas, but it is a matter which calls for the exercise of a sound and reasonable judgment upon a proper consideration of all relevant facts. The commission is not bound to adopt any one method to the exclusion of all others. It may take into consideration various methods, and use its judgment as to the extent to which either shall be employed. The original cost of the property is not to be taken as controlling, for there may have been extravagance in purchasing, or bad management; and, on the other hand, there may have been an actual increase in values since the original purchase or construction. Then again the reproduction cost less depreciation may not give the present fair value of an old property, for it may not now be desirable to reproduce the old type of plant. Improved machinery and better methods of operation may

have come into vogue, which would make it true economy to relegate much of the physical structure of an old plant to the scrap heap. Much must be left to the sound discretion of the appraising body, the tribunal appointed by law and informed by experience, for the discharge of these delicate and complex duties.

A careful examination of the voluminous record in this case has led us to the conclusion that in the items wherein the Superior Court differed from the commission upon the question of values there was merely the substitution of its judgment for that of the commission, in determining that the order of the latter was unreasonable.

The order of the Superior Court is therefore reversed and the order of the Public Service Commission is reinstated; the costs in the Superior Court and in this court to be paid by the Ohio Valley Water Company.

It is evident throughout the Supreme Court's decision that it considered the actual circumstances in each point, and its opinion concerning value is governed largely by what was actually spent. It happened that very complete books had been kept and preserved from the early days of each of the numerous water companies which were later merged to form the Ohio Valley Consolidated Water Co. These books were thoroughly audited and reports by three sets of auditors on the actual money cost of the property were presented in evidence.

Thus in its discussion of the allowance made by the commission for interest during construction the Supreme Court said that as the plant grew gradually, much of it was actually built while the rest was operating and taking care of interest during construction.

Regarding bond discount, the Supreme Court said that none should be allowed, but it went further by saying that if the company had actually paid brokerage "such an item should properly be considered in connection with the interest charged and should not be included in the capital classification."

In the matter of going value, the Supreme Court intimates that inasmuch as the depreciated book cost of the property was found to be $783,194, and the commission allowed $924,744 as the fair value, there was a very considerable allowance made for the fact that the property was a going concern. The sum of $924,744 is an approximate mean between the book and reproduction costs of the property.

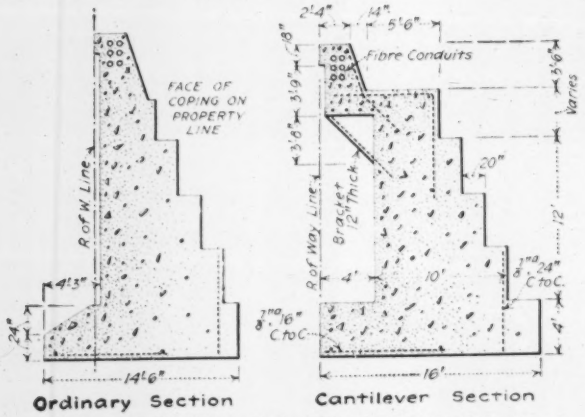
The Supreme Court closes with the statement that in the items wherein the Supreme Court differed from the Public Service Commission upon the question of values there was merely the substitution of its judgment for that of the commission, the inference being that the commission being experienced in such cases, and appointed for this purpose, its judgment should be final when the courts find that its judgment is supported by competent evidence.

Many engineers were engaged in the case, the principal ones being Chester & Fleming and Morris Knowles for the company and Leo Hudson and the writer for the various municipalities whose interests were involved in the proceedings.

Cantilevered Coping Permits Use of Full Width of Property

Overhang of Rock Island Retaining Wall Reaches Right-of-Way Line—Wall Topped by Simple Concrete Parapet

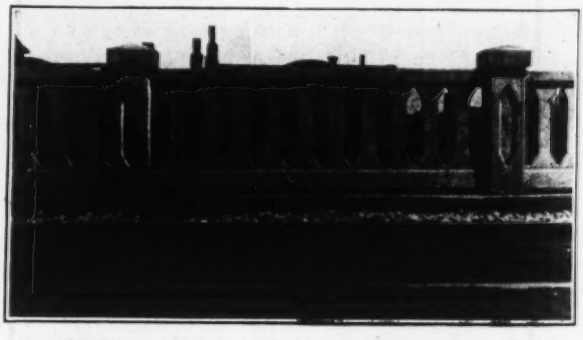
HIGH cost of property adjacent to the railway right-of-way in large cities has led the engineers of the Rock Island Lines to adopt for track-elevation work a retaining wall with cantilever top which permits utilization of the full width of right-of-way without encroaching on abutting property. The toe of the footing extends to the property line, and the wall itself is thus necessarily set back from the line. Ordinarily this would result in losing the use of a 3-ft. to 5-ft. strip of the land owned by the railway.



RETAINING WALL HAS FOOTING AND COPING ON PROPERTY LINE

Such loss is avoided by extending the top of the wall as a cantilever rib, so that its face is directly over the property line. In the typical design shown by the drawing there is a cantilever projection of 4 ft., with brackets from the wall at intervals of 10 to 12½ ft. It will be noted that the curb wall which retains the ballast is utilized to carry fiber ducts for power and transmission wires, thereby eliminating all pole lines.

Drains in the fill behind the retaining walls lead to chambers formed in the abutments of the subway



CONCRETE RAILING SURMOUNTS RETAINING WALL

bridges and connected to the city sewers. Some of these chambers are accessible by manholes carried up through the abutments and having iron covers at the track level. In later work an improvement eliminates these manholes, the chamber being closed at the top but having an opening in the side of the abutment wall. This opening is at the ground level and is fitted with an iron door.

Concrete parapets or railings which surmount the retaining walls at some points are designed as the result of an exhaustive study to secure a cheap but effec-

tive railing of pleasing design and facility in erection. This is shown in the accompanying view. It costs about 75 cents per lineal foot in place. The railing is cast in 10-ft. sections in the yards provided for this and other concrete work.

Upper and lower rails are 10 ft. long, and at the middle of the latter is a supporting leg which rests on the retaining wall. These rails are carried by the posts, and the space between them is filled by I-shaped verticals or 3 x 5 in. balusters in section. Steel forms of the Blaw type are used, and are removed after 24 hours. Concrete is a 1:2:2 mix, using 1-in. gravel.

Design and construction of these walls and railings are under the regular track-elevation forces of the Rock Island Lines. Robert H. Ford is engineer of track elevation.

Make Practical Tests for Concrete and Steel Paints

Painted Surfaces Actually Exposed and Only Compounds That Withstand the Weather Are Approved

MANY special paints for concrete and steel surfaces have been urged upon the California Board of Harbor Commissioners. Practical tests to which all can be referred have therefore become a necessary protection for the engineer in charge. Accordingly, a plan has been worked out whereby each claimant to "the best" product is given an opportunity to demonstrate what his compound will do in comparison with others. The plan has been highly satisfactory in that it has silenced the insistent salesman with worthless compounds and has furnished valuable information as to the qualities of different paints.

Any manufacturer's representative may have his paint tested for its adaptability to the use for which he makes claims for it. When the paints are brought in they are given a laboratory number and are known only by this number henceforth, and the manufacturer can only be known when the key is available. Thus the manufacturer can inspect his own paint without knowing whose paint, whether good or bad, is on the other panels. An inspection can be made by the manufacturer's agent at any time and be can see for himself the weathering of his product.

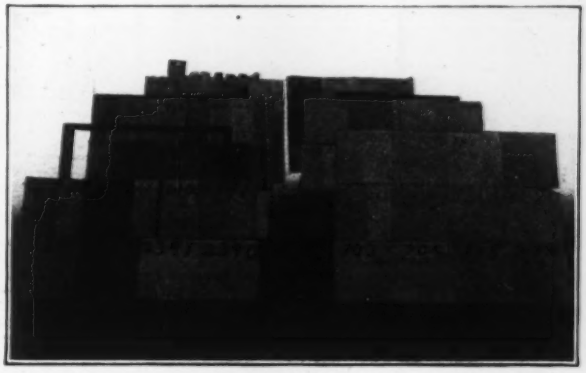
The paints for concrete surfaces are tested on slabs of mortar 1½ x 12 in. x 4 ft., which are made in the proportion of one part of cement to two parts of sand. This mixture is a little richer than the mortar used in most of the stucco work, but it has been deemed advisable to make the conditions as severe as possible. The slabs are aged for 28 days in the air and then the paint is applied without any preparation of the surface except where a manufacturer has recommended the use of a special neutralized agent. An area of one square foot is allotted to each paint and the first coat is spread on the surface. After 48 hours the second coat is applied to one-half of the surface, thus giving a strip with one and two coats. After the second coat is dry the slab is put on the roof of a shed adjacent to the testing laboratory.

This shed is built on the waterfront and is exposed to the salt air as well as the smoke of the ferryboats. The slabs are placed on easels facing the south and are left there until the paints have failed. As stated intervals inspections are had and a record made of general appearance and susceptibility to chalking, cracking or peeling. A paint is said to have failed either when it develops a tendency to crack or peel—this nature of failure having been found to be one of the worst to remedy when the structure is repainted—or when excessive chalking appears. The latter fault is not considered as serious as cracking or peeling, but it is noted and the paint rated accordingly.

The tests on concrete paints were started in 1915, at which time about 40 different kinds of paints were exposed. Since that time about 25 more have been added. The last inspection of the slabs show that out of the 65 so-called special paints there are only four that can be classed as first-class paints on concrete. The nature of failures has varied from peeling from the slab to a disappearance of the paint due to excessive chalking.

One of the best paints is made up of two coats, the first being intended not only to neutralize any free lime present in the concrete but also to form a "tooth" with which to anchor to the concrete a surface to which the second coat can be bound. The second coat is designed to seal the first coat with an impervious covering.

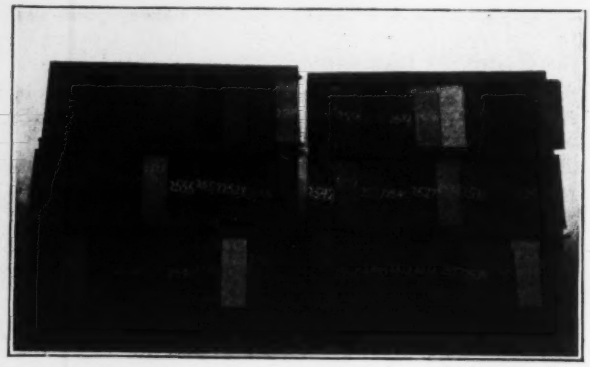
The paints for steel surfaces are tested on steel panels 18 x 6 in., cut from ten-gage metal. The metal is first



ONE SQUARE FOOT ALLOTED TO EACH CONCRETE PAINT

thoroughly cleaned. Then a coat of red lead is put on one side of each plate followed by a coat of graphite. This is allowed to dry thoroughly before the different paints are applied to the cleaned surface on the other side. The paints are applied in two coat work, 48 hours being allowed for the first coat to dry. When the second coat is dry they are placed out on the roof on easels. Steel paint tests were started in 1917 with about 60 different kinds ranging from linseed oil paints to tar and asphaltic compounds. Besides the steel paints submitted by manufacturers some substitutes for linseed oil were tested out, using red lead for the pigment. An inspection at the end of two months showed one or two of the paints rusting badly and an inspection at the end of a year shows about sixteen of them to be absolute failures.

When paints for either concrete or steel are offered for test, samples are preserved and if the weathering qualities are approved the samples are analyzed. Thus



STEEL PAINTS ARE TESTED ON INDIVIDUAL PANELS

when an order is placed for paint, samples are taken at random on the job and the analysis of these must agree with that in the laboratory record before the paint is accepted.

This method of testing has worked out very satisfactorily for both the manufacturer and the engineer in charge. In some cases the manufacturer has seen the faults in his paint and has tried to remedy them. Meantime the engineer has avoided the acceptance of inferior paints and charges of unfairness or discrimination.

The work is under the direction of F. G. White, chief engineer of the harbor commission, and the testing laboratory is under the direction of A. A. M. Russell, testing engineer of the harbor commission.

SOCIETY SERVICE

A Section Dealing with the Results of Teamwork by Technical Men

St. Paul Engineers Urge Better Car Service

Street car service fluctuating to meet the traffic rather than a fixed schedule, is proposed by the St. Paul Engineers' Society to the city officials as the criterion in framing an ordinance calling for better service. An ordinance is under consideration providing for fixed schedules and the public affairs committee of the society has taken an active part in the public hearings. It has also conferred with the chief engineer and general manager of the company in regard to the proposed methods for regulating the service. As a result it has agreed that the ordinance finally adopted should be based upon a scientific study of traffic requirements and should be so framed as to permit of flexibility in operation. Part of the committee's recommendation relating to a maximum limit for the maximum average load during the rush hours has been embodied in a measure introduced, approved and laid over for final action.

A building code committee in coöperation with other organizations is well on the way toward realizing its effort of obtaining an expert, experienced in engineering, building construction and specification writing to rewrite and edit a building code for St. Paul.

P. E. Stevens, president, states that where the public service activities may not be more than in past years there is this significant difference: in former years it was necessary to seek an opportunity; now the organization is sought out frequently and advice and influence asked for.

Will Military Work Bring Chicago Engineers Together?

An extraordinary effort is being made in Chicago to bring the numerous engineering societies together for war work. The Western Society of Engineers is the leader in the movement, through its military committee headed by Frederick K. Copeland, president of the Sullivan Machinery Co. Aside from the 14 branches of the national organizations there are 5 national and 11 local societies which can function, it is believed, for such matters as the coming Liberty Loan, much better if all organizations are coördinated. Possibly from this may grow an acquaintance which will break down the barriers of reserve, suspicion, or what not, that keeps this multiplicity of organization on which the lay-public looks, if it looks at all, with indifference because of the small non-unified units.

The Western Society is launching a formidable drive for members. It now is in the stage of seeking the names of prospects to whom it may send engraved invitations to attend meetings in which the prospect is specially interested. A booklet giving the reasons for joining the society, made up in attractive form, and an invitation to join, will be sent at a later date. Further follow-up literature will be sent, making four announcement cards of meetings in all. Other details of the campaign have been worked out in advance, and special attention has been given by the program committee to make the meetings valuable. As an example, the subjects Mar. 19, the week during which the American Railway Engineering Association was in session, were on "Meeting the Material Situation," and "What the Engineer Can Expect from Industries Supplying the Basic Engineering Materials." F. J. Llewellyn of the American Bridge Co. spoke for the steel plants, Herman Von Schrenck, consulting engineer, for the lumber industry and B. F. Affleck, president of the Portland Cement Association, for concrete.

More and more engineering society officers are finding it essential to keep all members in touch with what is going on. The Illinois Society of Engineers has recently put out its latest one-sheet bulletin analyzing the annual meeting and telling what was done there. The bulletin of the Affiliated Engineering Societies of Minnesota now runs to 70 pages and shows very clearly the benefits of coöperation of local societies. The newly-formed Association of Ohio Engineering Societies has started out with a four-page sheet giving the minutes of the first meeting. The Oregon Society of Engineers gets out a 12-page bulletin occasionally. Its aim is to provide a medium by which the secretary may discuss society matters with the members.

A series of educational lectures has been given in Portland, under the auspices of the Oregon Engineering Society, by the extension department of the Oregon Agricultural College. Three subjects were taken up,

one per month from October to May. The society collected $3 per capita for the course and the college allowed credits leading to a professional degree.

The Western Society of Engineers has found the course on aviation, given under its auspices by the Lewis Institute branch, well attended, particularly by young men about to enter the service with the Signal Corps.

LETTERS TO THE EDITOR

Comment on Matters of Interest to Engineers and Contractors Will Be Welcome

How Can Efficient "Engineering Coöperation" Be Secured?

SIR—In *Engineering News-Record* of Mar. 7 there was printed the address of C. E. Drayer before the Minnesota Joint Engineering Board, in which he criticised the Engineering Council for not admitting to its membership representatives from the various local engineering societies, and declared that the Council had failed to accomplish what the profession expected, and urged the federation of the various local engineering societies on the plan of the United States Chamber of Commerce.

The questions raised by Mr. Drayer's paper are of general interest and what he says deserves attention because of the fine work he has done in building up the Cleveland Engineering Society and in stimulating the development of local engineering organizations generally.

In considering these questions, however, let us remember that it is the engineer's duty to observe in all his work the principles of efficiency. Engineers have led in developing the science of organization, and there is every reason why they should apply the principles of that science in planning their own professional organizations.

Let us clearly understand at the outset just what is meant by the terms "federation" and "coöperation" and "engineering unity," of which so much has been heard. They do not mean consolidation, of course. No one seriously advocates the merging of the identity of the several societies, either the local clubs or the national organizations which cover specific branches of the profession. What these terms mean, and all they mean, is that when certain matters arise on which it is desirable that the profession should act as a unit, there should be an organization ready to take such action.

The much talked of "engineering unity," then, means only this and nothing more. No federation or consolidation of either local or national engineering societies could possibly hope to accomplish better work in either the social or the technical field than the individual societies now are doing. It is well to clearly understand this in order not to expect too large results from any cooperative movement of engineering societies however organized.

It happens that the writer has been familiar with several of the attempts that have been made to create an organization which could bring about "engineering unity" as above defined.

The first important effort of this sort was the joint conference committee of the national engineering societies. This was organized half a dozen years or more ago with representatives appointed by half a dozen of the principal national engineering societies. Soon after its formation it succeeded in accomplishing one or two specific tasks, such as the creation of the organization to underwrite the Engineering Congress of 1915 in connection with the Panama Pacific Exposition. This committee had no power, however, to do anything except by first planning out a course of procedure and submitting it to each of the societies represented on the committee for formal approval before any action could be taken. It was impossible to accomplish anything of moment under such a scheme, and after trying unsuccessfully to obtain authority to do efficient work the committee became inactive.

Within the past two years several independent plans to create an efficient organization for "engineering unity" have been agitated, but nothing practical was accomplished until the formation last summer of the Engineering Council. This is now made up of representatives elected by the governing bodies of each of the four national engineering societies, and provision has recently been made for the admission of representatives of other engineering societies.

Whether its existence is justified by what it has done in the few months since its organization is a matter on which opinions may differ. Very possibly Mr. Drayer's adverse opinion may be due to a failure to understand the difficulties of organizing any such movement in a way to secure efficient action.

It is not proposed to discuss here the specific achievements of the council, but the pertinent question raised by Mr. Drayer's article as to what form of coöperation between engineering societies should be put into effect to secure efficient work.

Suppose that Mr. Drayer's proposition were carried into effect, and 20 to 50 local engineering societies were to elect representatives either to the Engineering Council or to an independent federation or "parliament" of such societies. Could such an organization do active, efficient work for the profession?

Or again, take Mr. Drayer's other scheme, a federation along the lines of the United States Chamber of Commerce, where any proposed action would first have to be formulated by a committee and then balloted on by each of the local societies.

Imagine one of those organizations asked to deal with such questions as are now coming before the Engineering Council, like the one recently acted on where an appeal was made by an engineer that the council should endeavor to secure from the Federal railway administration an increase of pay for the professional engineers engaged in railway service. The matter was referred to the committee on public affairs, and by that committee, the executive committee and the council's secretary, arrangements were made to have the case effectively presented on behalf of the railway engineers before the Railway Wage Commission at its recent sessions in Washington. If it had been necessary to send out a ballot to a list of societies, or even to a list of council

members scattered in all parts of the country, before a decision could have been reached, and action taken it would have been impossible to have obtained authority to act in time to do any good.

The above illustration is not exceptional, but typical, of matters which come before the council. To put the matter concisely in another way: If engineers want to have things done in which the profession as a whole is deeply interested they must provide an organization efficient enough to do the job, or nothing but talk will result. If any other organization can be planned out and brought into being which will be more effective than the Engineering Council, by all means let it be done. When the thing is demonstrated the engineers, who as members of the council are giving their time for the general benefit of the profession, will gladly relinquish their task to others.

But let those who work on any such plans, as well as those who judge the work of the Engineering Council, keep clearly in mind the necessary difficulties and limitations of any such organization. The larger the membership of a committee or board or council or any other deliberative body and the more diverse and scattered the elements represented in it, the greater the amount of compromise and delay and uncertainty which will attend its action.

Those who are familiar with the amount of work, discussion and compromise which was necessary to bring the Engineering Council into being can appreciate its importance to the profession if anything practical and successful in the way of united action for the benefit of the profession as a whole is to be achieved.

New York City. CHARLES WHITING BAKER.

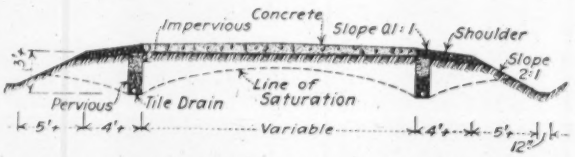
Frost Action on Rigid Pavements

Sir—In regard to the heaving of concrete pavements as described by J. L. Harrison in the *Engineering News-Record*, p. 418, Feb. 28, I am in general agreement as to the cause of this trouble, although I think he places a little too much emphasis on alternate thawing and freezing. In most cases I have noted this heaving to be steadily progressive over a considerable period when the temperature was at no time above zero.

It seems to me that a better way of stating the case, and one that comes more nearly describing what actually takes place, is that the heaving is due to a gradual accumulation of ice between the concrete and the sub-base, where free water has effected an entrance, and that a thaw is often responsible for the presence of this free water.

As to the forms of construction proposed by Mr. Harrison to overcome this difficulty, I have found here in Duluth that the worst heaving has occurred in cases where just such a sub-base as he recommends had been provided. Water is admitted too readily between the concrete and sub-grade.

In connection with the four requirements established as necessary in order to prevent the harmful effects of this combined action of frost and water, I am quite in accord with the first: "The ditches should be placed far enough below the bottom of the concrete pavement that there can never be any direct leakage from the ditches into any part of the sub-grade that might thaw out during the winter." In the second requirement instead of saying: "The base should be constructed so that any leakage through the shoulders or through cracks in the pavement can drain into the ditches at once," I would say, the base should be so constructed that any leakage through the shoulder or through cracks in the pavement will be reduced to a minimum. For the third requirement, providing for a sub-base, I would



PAVEMENT SECTION TO ELIMINATE FROST ACTION

substitute a provision as to drainage somewhat as follows: Adequate provision should be made for draining the sub-grade by placing tile on each side of the pavement, which tile should not only be deep enough to be protected from the frost, but also deep enough to lower the line of saturation well below the sub-grade. I think the fourth requirement very good and would not suggest any change: "All side ditches and lateral drain ditches must be so sloped that surface water will be thoroughly and promptly drained off."

I am inclosing a sketch of a cross-section that I think preferable to that proposed by Mr. Harrison, in that it is not only cheaper but more effective in preventing heaving. Of course there can be no standard design in work of this kind; each case must be treated in accordance with local soil and climatic conditions. The problem is to thoroughly understand the disease and then apply the remedies. In placing tile drain the character of the soil, the amount of water to be taken care of and the width of the pavement should all be considered, and as a general principle I would never put a drain under the pavement. A great many defects can be traced to this practice. The sub-grade should be as uniform and solid as possible and this can never be accomplished where a great deal of ditching is required. JOHN WILSON,

Duluth, Minn. Consulting Engineer.

"Angles to the Right" a Useful Surveying Method

Sir—No doubt a good many of your readers are already familiar with the advantages of the method of surveying known as "angles to the right," but there are probably a good many others who have never had it called to their attention. The writer was in the latter classification until he moved to a Western state two years ago, but since then he has become an ardent believer in the method and an enthusiastic booster for it.

The method consists in taking all horizontal angles "to the right," or in a clockwise direction, no matter whether this makes them interior or exterior angles, and regardless of the resulting size of the angle, taking the backsight at each station with the plates set at zero. It is therefore somewhat similar to the ordinary azimuth method, with the difference that the zero point is the backsight at the station occupied instead of the south point.

The advantages which the advocates of the method claim for it are:

1. There is less chance for error in recording the angles than when deflection angles are used, for in this method there are no "left" angles. Also the error introduced in plunging the telescope is eliminated.

2. A sketch is not necessary to show which way the angle was read, as is the case with interior or exterior angles.

3. There is less chance for error if all angles are read in one direction than if some are read one way and others in the opposite direction, as the enginer very quickly becomes accustomed to reading all angles one way and does so instinctively.

4. Unlike the azimuth method, the angles can be doubled, or in fact repeated as often as desired, which is the best way with which the writer is familiar of checking work in the field.

5. The angles may be very easily transformed into deflection angles if desired for plotting, by one simple mental subtraction, as follows:

> If the angle to the right is *more* than 180°, subtract 180° from the angle, and the result will be the deflection angle to the *right*.
>
> If the angle to the right is *less* than 180°, subtract the angle from 180°, and the result will be the deflection angle to the *left*.

6. For computing azimuths and calculated bearings, either for plotting or computation, notes of angles to the right may be reduced much more easily than any other form of notes, as they can be computed by a process involving only simple addition and subtraction, and a simple rule may be written which will cover all cases. The rule is:

> To the last azimuth (that of the line coming *up to* the station occupied) add the angle to the right, subtract 180°, and the result is the new azimuth. If it is impossible to subtract 180° as above, *add it*.

This rule covers all cases, and is very simple and easy to remember, requiring no elaborate sketches to determine the new bearing, for of course the relation between the azimuth and the bearing of a line is too simple to need comment. It therefore does away with what is considered by most engineers a bugbear if nothing worse—the computation of calculated bearings.

The second sentence of the rule is of course equivalent to first adding 360° and then subtracting the 180° as before, and of course the addition of 360° to an azimuth does not change it. Similarly, another sentence might be added to the rule, as follows:

> If, *after* subtracting the 180° as above, the remainder is larger than 360° subtract 360°.

This rule should, however, be self-evident, as of course an azimuth of 390° is the same as one of 30°.

This method of surveying is applicable to any sort of surveying with which the writer is familiar, and indeed he has become so attached to it that he uses it for all his surveying work.

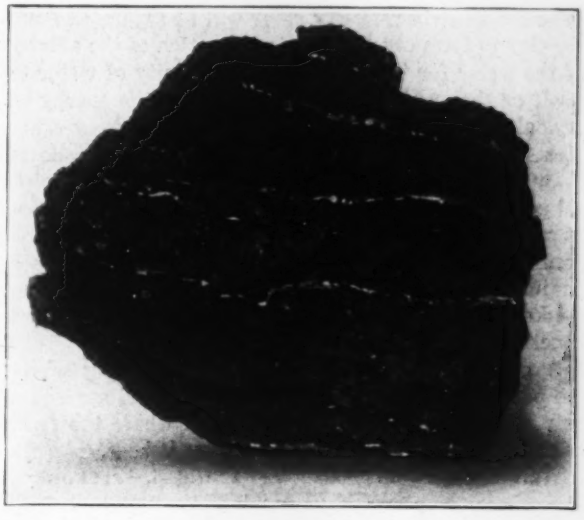
From his observation in the East and Middle West, the writer believes this method to be in rather general use in the Western states, but very little known in the East, and it is in the hope that this letter may prove of interest and possibly of some value to your Eastern readers that he begs the indulgence of your columns.

H. H. ARMSBY,
Instructor in Civil Engineering, University of Missouri.
Rolla, Mo.

Some Observations on Effect of Frost in Raising Weight

Sir—The article by Professor Taber, in *Engineering News-Record*, Feb. 7, 1918, p. 262, on the action of frost in the ground is particularly interesting to engineers doing work in northern climates. It is ironical, however, that the explanation should come from a Southerner who has to wait for a cold night to make experiments.

The writer has been in charge of work in northern New York where the thermometer has been below zero



SIX-INCH LUMP OF CLAY LAMINATED WITH ICE FORMED WHEN IT WAS IN THE GROUND

for weeks and the frost has penetrated to a depth of 4 ft. in exposed places. He has witnessed the raising of whole buildings and has examined earth excavated near the affected parts.

In one case a brick wall giving an earth pressure of 2000 lb. per sq.ft. was raised ¾-in. and several piers supporting columns and roof trusses were raised from ½ to 2¾ in. At first the engineers were blamed for giving wrong grades. The instruments were taken out and checked and other engineers put on to run the grades again. It was not until the same piers were checked on successive days and found to be rising that the cause was determined.

Later some excavation was being made near some of these piers and the writer made an examination of the soil. The accompanying photograph shows how the ice was found to lie in layers throughout the clay. The closeness of these layers of ice varied according to the amount of moisture in the soil and probably according to the rate of cooling. In some places the veins would be like hair cracks and close together; in other places they would be as large as ⅜ in. and several inches apart.

In very dry clay isolated crystals would be the rule. The lump shown in this picture is about 6 in. high and shows a total of ¾ to ½ in. of ice.

Experiments were made to determine how much shrinkage would attend the extracting of water from saturated clay. A box of wet clay 12 in. square and 12 in. deep was set by a raidator and about 150 lb. weight placed on top of it. When it had given up about 10 lb. of water less than $\frac{1}{16}$ in. shrinkage was shown. A smaller sample set on a hot stone showed an increase in volume, but this was probably due to a formation of steam and the baking of the clay while thus expanded. Of course, if the water and clay could be separated and the clay still occupy the same space the ice formed of the water would raise any superimposed load.

Professor Taber has pointed out the fact that this separation of clay and water does occur; the writer's observations verify it. It is not only on the surface that the ice forms, as Professor Taber's article would indicate, but at any depth where the heat is withdrawn to such an extent that the water will be separated from the clay to form crystals. It is a question of the affinity of the water for the clay versus the affinity of water to itself or the energy of separation versus the energy of crystallization. A crystal once formed will draw other atoms of the same material to it. It will continue to draw until the temperature either rises above the critical point or until the critical temperature is established at a neighboring point. When the latter condition occurs a new layer of ice will form. Thus we see a laminated structure in the frozen ground with varying thicknesses of ice and clay dependent on the rate of penetration and the quantity of moisture.

A coarse sand cushion might prevent rising where the penetration of frost is light, but it would seem that only a deep footing could be relied on where the frost penetrates to such a depth as we have it here.

Watertown, N. Y. LEWIS B. WYCKOFF.

Relief Maps Made With Nails, Sawdust and Plaster Paris

Sir—The writer has often found it worth while, in connection with engineering testimony in court, to introduce a relief model of the locality involved. Such a model is much better understood by the average jury—and judge—than a contour map. Since the ordinary method of making a topographic model, by cutting out the individual contours from sheets of uniform thickness and building up, is quite a laborious process, and since it is often hard to obtain sheets of proper dimensions and workability, the writer has had recourse to the following method:

Having determined the size of the model, both horizontal and vertical, construct a box of soft tongued and grooved wood, with walls about the maximum height of the model. Lay off on your contour map a set of coördinates, and transfer them to the floor of the box, extending them to the top edge of the sides. Section and subdivision or lot and block lines may take the place coördinates. Using the lowest point in the area as a base elevation, equivalent to the floor of the box, take off the difference of elevation to each intersection point, reduce to inches and fractions of the vertical scale and write down at the corresponding point on the box floor.

Then, from a box of assorted nails, select for each point a nail of such length that, when driven firmly into the bottom, the head will come to the proper height. Fill the box with fine sawdust so that the nail-heads project slightly. Sprinkle the sawdust with plaster of paris, then sprinkle with water. Repeat the process until the nail heads are covered. The plaster hardens rapidly, and a firm base is soon obtained. Make a thin mixture of plaster and water and smooth over the model with the fingers. When dry, paint over with flat white prepared paint.

Now pick up the coördinate lines from the edge of the box and extend them across the model, transfer with india ink and water colors such data from your maps as is desirable, letter, tint with water colors, cover with a coat of white shellac, and the model is complete. Some small holes bored in the bottom boards will take off the surplus moisture.

Where extreme accuracy is not necessary this will be found a quick and easy method of producing a light and serviceable model. W. C. MULDROW,

Okanogan, Wash. City Engineer.

Use of the Median in Rainfall Statistics Advocated

Sir—In predicting rainfall the writer believes that instead of using average monthly figures for the period being studied it is better to obtain the median precipitation for each month and to total the medians for all the months to obtain the more probable annual average. A similar method is frequently used in analyzing run-off data. By median is meant precipitation than which there are as many occurrences greater as there are less.

By using the median, the indicated average annual precipitation will be reduced in many instances from 8% to 15% from the results obtained by the ordinary average method. For example, the median precipitation at Boston deduced from records published a short time ago in the *Journal* of the New England Water-Works Association becomes 42.01 instead of 45.46 in., a reduction of the average given of about 8%.

The writer is of the opinion that both the arithmetical monthly average and the monthly median should be given in all basic tables where the data are complete enough to warrant it, and the annual totals given in both cases.

The writer would like to call this to the attention of your readers for purposes of discussion.

Boston. DANA M. WOOD.

Relining Railroad Curves

Sir—In reading my letter, published in your issue of Mar. 14, in regard to relining railroad curves, I find that I have made the following mistake: In the paragraph beginning "In the cast of long curves," the sentence, "The distance DC, CG, HC and HM can readily be calculated, M located, and HM measured," should read, "The distances DC, CG, HC and HE (or HF) can," etc. G. F. SCHLESINGER.

Assistant Professor of Civil Engineering, Ohio State University.

Columbus.

HINTS FOR THE CONTRACTOR

DETAILS WHICH SAVE TIME AND LABOR ON CONSTRUCTION WORK

Three Types of Plank Motor-Truck Roads Work Well in Logging

A KIND of motor-truck road used by contractors, notably on the Cleveland subway cut, has been developed successfully for heavy loads on forest soil in logging work. Three types of roads have been employed. Increase in the size of loads of logs which can be hauled by motor trucks over those formerly hauled by team has caused the development, roads of greater bearing power being secured with three types used extensively on the west coast, which are described in the *American Lumberman*.

FORE AND AFT PLANK ROAD LAID ON CORDUROY

The fore-and-aft road is one where the planks or logs are laid longitudinally. When logs are used, small trees 12 to 14 in. in diameter are selected and smoothed with an axe on two sides. This gives a bearing of 24 to 30 in. These logs are laid in pairs, with broken joints, and a cross-tie is laid under each joint. Frequently the logs are partially buried beneath the surface to make them secure and prevent slipping. In a clay formation the logs are sometimes set flush with the surface and scored deeply so that greater traction may be secured. On steep grades they usually are scored. Where desired planks may be substituted for the logs and treated in the same manner.

A second type is known as the plank road. In this case the roadbed is roughly graded and stringers 3 or 4 in. in diameter are laid, having their tops flush with the surface of the ground. The planks are then laid crosswise. Planks of any desired thickness may be used, but ordinarily the thickness runs from 3 to 4 inches.

The third type of road is known as the puncheon or corduroy fore-and aft road. In construction, it is not unlike the famous corduroy road of history. Small logs and limbs are trimmed to proper length and laid on the ground, frequently being set flush with the ground or even having a little dirt spread over the surface. On top of these are laid heavy planks generally 4 in. thick and from 12 to 20 in. wide. Roads of this character give the truck wheels excellent bearing surface.

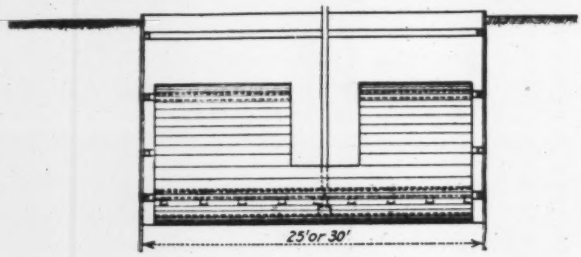
The 5-ton truck in the illustration, being loaded with spruce for airplane construction, is at the end of a common fore-and-aft road. It belongs to A. H. Mayo, Enumclaw, Wash., and makes six trips a day over a 4½-mile haul from the woods to the railroad. The owner states that he can start a 4000-ft. load up a 22% grade easier than he can an ordinary touring car.

Logging roads of the character described have only been in use from two to three years so that it is impossible to tell how long they will last. Where heavy logs are employed in building fore-and-aft roads it has been found, however, that there is little upkeep cost, while on the puncheon or corduroy and plank roads the upkeep is purely nominal. In the vicinity of Seattle the average fore-and-aft road has cost about $2000 a mile to build. The corduroy or puncheon fore-and-aft road costs from $2000 to $2500 per mile, while the straight plank road in some cases has cost as much as $3000 a mile. Costs in such cases, of course, depend entirely on the price of planks used or on the price of logs or stumpage.

Various means are used to turn the trucks and trailers, one of the most successful of which is a motor truck turntable, easily constructed of timbers and planks.

Short Open Cut For Starting Tunnel Better Than Shaft

CONGESTION at the bottom of the shaft at the start of the headings is being eliminated out on the Evanston Intercepting Sewer by Dan O'Connor, superintendent for the contractors, the Nash-Dowdle Co., by building a short section of the work in open cut at each shaft. As the cover is shallow this entails but little extra excavation and sheeting. Its advantage comes in the ability to erect hoist and pumps before starting headings and in the ease with which the tunnel headings are started. The track is laid in the bottom of the finished section of concrete sewer in the open cut and is ready to hold cars while the work is started. There is room in the pipe for the extra tools and planking, etc., which are required for the work. If this



TUNNEL EASIER TO START FROM SHORT CUT

were not the case the car would have to stand on the cage and there would be no room at all for the tools.

By using the poling method of starting the first headings, the concrete in place serving as a guide for the poling boards, a great deal of difficulty is avoided in this part of the work. The shallow cover would be likely to cave and keep caving as each successive cut were made. The poling boards keep any cave from starting.

Another advantage is that the hoist may be erected and ready when the time comes to dig the first heading. Starting from a shaft the first headings would have to be scaffolded out.

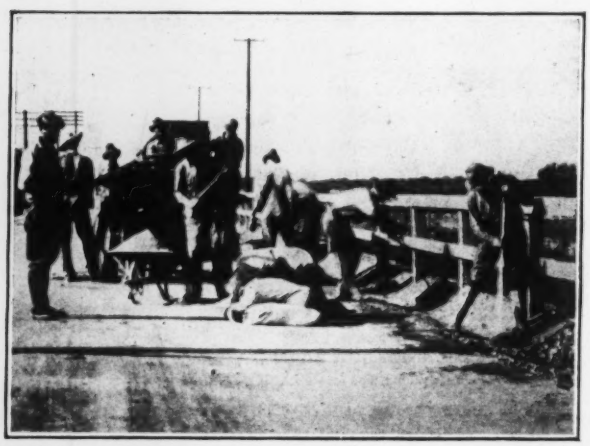
Grouted Gutter Is Easily Finished with Small Gang

By E. Earl Glass

Monrovia, Calif.

THE crew necessary for a small grout mixer, with two men on the finishing, built a mile of concrete gutter in Los Angeles County recently by pouring the grout over broken stone laid to the section of the gutter, tamping it with a wood tamper and finishing it with a street broom.

The gutter protected the side slopes of the approach to the Bassett bridge, which was being paved with bituminous macadam on top of the original granite base, left since the completion of the bridge for final settlement of the sand fill. The gutter grade was shaped with shovels and a 4-in. layer of broken stone ranging from ¾-in. to 3-in. in size tamped to the proper section. A mixer crew followed this work with a small machine making 1:3 mortar which was shoveled on the broken stone, tamped with a 12-in. length of 2 x 4 attached to a vertical handle, and finished with the broom. The method reduced the handling of the materials, as the stone did not pass through the mixer, and of course effected great saving over the usual way of constructing a concrete gutter.



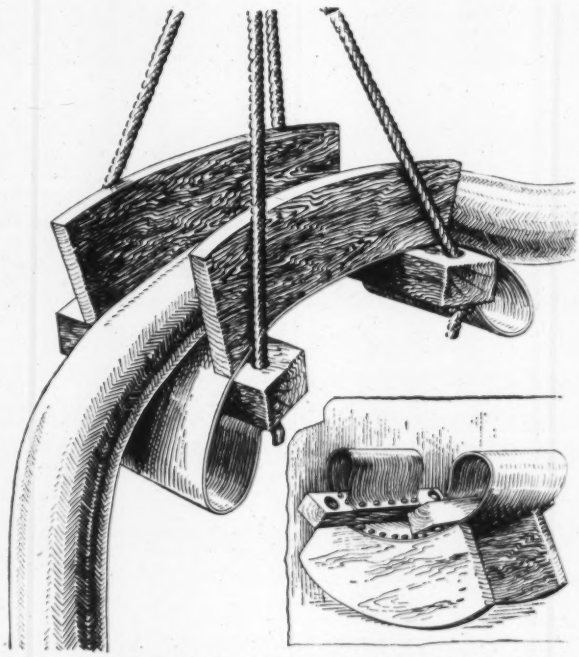
GROUT TAMPED AND FINISHED WITH STREET BROOM

Saddle Supports Hose in Crusher Plant

By L. V. Lauther

New York City.

EVERY one has seen a hose tied up with string where its weight drags on a spud coupled to a horizontal pipe at some distance from the floor. Sometimes more pains are taken, as in a stone crushing plant where the writer rigged up the counterweighted saddle shown in the sketch. It was easily made of four pieces of wood, a strip of galvanized sheet iron, a 4-part sling of sash cord and small scrap casting for counterweight. The curve was made somewhat flatter than the curve the hose took in filling with water, to prevent kinking. Several lengths of hose broke before the saddle was put in, after which, of course, the trouble ceased.



CURVE MADE FLAT ENOUGH TO PREVENT KINKING

First Estimate of 1917 Lumber Cut

Lumber production in the United States of 39,200,000,000 ft. in 1917, or a decrease of 2 per cent. as compared with the cut of 1916, is the estimate made by the Forest Service based on incomplete reports received up to Feb. 26. About one-half of the 34,000 mills listed by the Forest Service and the National Lumber Manufacturers Association had at that time made reports. Because of the need for an accurate census caused by country's wartime demands for lumber, officials in charge of the work are urging delinquent mills to report as soon as possible. The estimate is based upon the reported cut of 845 sawmills, each of which cut 5,000,000 ft. or more of lumber in either 1917 or the preceding year.

NEWS OF THE WEEK

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

Part of Calaveras Earth Dam Slips Into Reservoir

Serious Accident to the Highest Structure of Its Type in the World. Large Section Slides

As this issue goes to press word has been received that a bad break has occurred in the Calaveras Dam near San Francisco, Calif. According to this report, which will be amplified in next week's issue, a large part of the upstream section of the dam slid out into the reservoir.

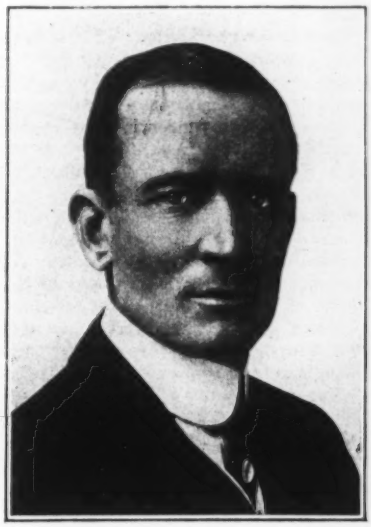
The Calaveras Dam, building about 36 miles southeast of San Francisco, is to be the highest earth dam in the world. It will be 240 ft. high, 1312 ft. wide at the base, 25 ft. wide at the crest and 1260 ft. long along the crest. It is being built by the hydraulic fill method, with no core, but with special effort to concentrate extra fine clay in the middle of the dam section. When completed it will hold back a reservoir of 55,000,000,000 gal. for the Spring Valley Water Co., San Francisco. Work was started early in the summer of 1914 and the dam had apparently reached a height of approximately 190 feet.

The report received states that on Sunday morning, Mar. 24, the central section of the upper part of the upstream side of the dam and a large part of the clay core back of it slid into the reservoir. The section that moved was about 700 ft. long and is roughly estimated at 800,000 cu.yd., or approximately one-third of the volume of the dam. There was 55 ft. of water in the reservoir above the dam at the time and the central pool stood 100 ft. higher and about 40 ft. below the top of the dam. The movement was very rapid, taking place in about five minutes. No one was on the dam at the time and there was no loss of life or damage of any kind beyond the loss of the work, which included a reinforced-concrete outlet tower thrown down in the slip. The water back of the dam was not lost.

Will Resume Work on Flood Control Project at Mill Creek

The Federal Bureau of Housing has reported that the early completion of the Mill Creek flood control project at Erie, Penn., is necessary as a war measure. Work is soon to begin on the completion of this project. Following the failure of the contractors on this work in November, 1917, construction stopped and has not been resumed. Local objections to construction have been withdrawn.

Thomas Riggs, Jr., Engineer, Nominated for Governor of Alaska by President



THOMAS RIGGS, JR.

Thomas Riggs, Jr., nominated by President Wilson as Governor of Alaska Territory, has been a member of the Alaskan Railroad Commission since May 6, 1914. He was born Oct. 17, 1873, in Howard County, Maryland, and was educated at the Emerson Institute, Washington, D. C., 1883-1890, and at the School of Science, Princeton, N. J., 1890-1893.

He had had experience in mine surveying and land surveying before being employed on the Alaska Boundary Survey. He passed a civil service examination and was appointed July 20, 1906, as a topographic aid in the U. S. Geological Survey, which appointment was made permanent on Oct. 6, 1907, but he did not serve under that appointment. He was appointed assistant surveyor on the Alaska Boundary Survey under the State Department (of which the Superintendent of the Coast and Geodetic Survey is Commissioner) Mar. 30, 1906, and was employed on that duty continuously until his appointment as a member of the commission. On Feb. 27, 1911, Mr. Riggs was promoted to the position of engineer to the Alaska Boundary Commission.

During his term of service in Alaska the 141st meridian boundary was surveyed and marked from the shores of the Arctic to Mt. St. Elias, a work involving great hardships and considerable danger. He was the first to use horses for transportation north of the Porcupine River and their appearance caused great astonishment among the Indian and Eskimo inhabitants of the region.

In 1911-1912 an epidemic of smallpox broke out among the Indians on the Porcupine River. It was handled so successfully by Mr. Riggs, with the assistance of the Canadian and U. S. authorities, that only one death occurred.

Mr. Riggs was married in 1913 to Miss Renée Coudert, daughter of the late Frederic R. Coudert of New York, who was commissioner for the United States on the Bering Sea arbitration. Mr. Riggs became an associate member of the American Society of Civil Engineers in 1909 and a member in 1915.

Attempt to Register Opinion of All Engineers in Referendum

Letter Ballot of American Association Asks Views on Academy of Engineers and Other Questions

A ballot has been sent out to some 250 engineering societies by the American Association of Engineers for the purpose of securing an opinion on public questions to be taken up at the fourth annual convention of this association May 14 next in Chicago.

The letter transmitting the ballot characterizes the first proposition to be voted on, the desirability of passing the bill incorporating an American Academy of Engineers, as undemocratic and un-American. According to the letter, this bill seeks to establish an aristocracy of engineers.

The second question, regarding the granting of A-1 priority for equipment needed for drainage work, is commented in the letter of transmittal as involving the serious question of producing sufficient foodstuffs during the next year.

The third question is that of universal military training. It is proposed later to submit referenda on the licensing of engineers, railway ownership and similar subjects.

This, according to A. H. Krom, general secretary of the association, is the first effort to obtain the opinion of the engineering profession on national questions by referendum.

The committee on engineering coöperation unites in extending an invitation from the American Association of Engineers to other organizations, asking them to send delegates to the annual meeting of the association in Chicago May 14 to consider coöperative plans.

Railway Engineers Discuss War Emergencies

Labor Problem Given Much Attention at A. R. E. A. Convention—What Can Be Done to Postpone Bridge Renewals

War conditions had a stimulating effect upon the annual convention of the American Railway Engineering Association, held at Chicago on Mar. 19 to 21. In attendance and in the character of the proceedings the meeting was well up to the standard of recent years. It was noticeable, however, that several of the committee reports were composed largely of matter submitted simply as information and not calling for action.

The address of the president, John G. Sullivan, chief engineer of the Canadian Pacific Railway's western system, was a call to the engineer to take a larger part in the active duties of citizenship and not isolate himself in his professional work. Great increase in railway traffic during recent years has been accompanied by only small increase in capital and in mileage, for capital has been frightened away by anti-railway legislation and regulation. For this he blamed the engineer in taking so little interest in politics and public affairs.

The reports of the secretary and treasurer showed a membership of 1387, a net gain of 17 for the year, and a balance of nearly $31,000. One hundred and three members are in war service.

Labor as the Great Problem

Two aspects of railway economics were dealt with by two new committees on the economics of labor and railway operation, but no report was made by the older committee on economics of railway location. The report of the first of these committees reviewed the serious conditions of the labor market, with shortage of supply and unsatisfactory quality. Methods of employment were reviewed, but more attention was given to the feeding and housing of the laborers.

Centralized labor agencies under the direction of the railways were suggested by E. R. Lewis (Duluth, South Shore & Atlantic Ry.) as a means of coping with the situation. Railways in need of men would apply to these agencies. Then in many cases it would be practicable to transfer gangs from one road to another, thus retaining the gangs intact and so maintaining their efficiency.

Labor-saving devices were referred to by this committee and the committee on ballast, and were illustrated by a series of slides and moving pictures.

Conservation was considered from some rather unusual points. The committee on conservation of natural resources called attention to large railway plants for saving and utilizing scrap, to the daylight saving movement, and to measures for the conservation of human life and energy.

Reduction of the numerous sizes of drawings and reports to a limited number of standards was advocated by the committee on records and accounts as a means of conserving material and labor. In one case it was found practicable to reduce the number of report forms from 1600 to 500, thus saving the work of the men who had to fill out these reports and also effecting a large saving in printing and paper.

Scientific organization of railway forces presents an opportunity for the conservation of energy, according to the report of the committee on rules and organization. In presenting the report A. J. Himes (New York, Chicago & St. Louis Ry.) pointed out the difference between scientific management and scientific organization, which deal with the efficiency of the individual and the organization respectively. Hitherto there has been general approval of the system of a single authoritative head, but times are changing, and study may show the possibility of greater efficiency in a representative organization actiong as a unit. There was very little discussion. Incidentally, the committee on water supply submitted a scheme of organization for a railway water department.

War Conditions Considered by Yards Committee

Of special prominence was the report of the committee on yards and terminals, outlining possible means of improvement in existing freight yards by which the handling of the heavy war traffic may be facilitated and congestion relieved. So important and practical is this part of the report considered that it has been published in pamphlet form for distribution to operating officers. (See Engineering News-Record of last week, p. 561.)

Bridge and trestle renewal as affected by war conditions and especially by the condition of the steel and timber markets came in for some discussion and a number of emergency expedients were mentioned. A. F. Robinson (A., T. & S. F. Ry.) referred to the impossibility of getting large timbers on account of the shipbuilding requirements. Both W. H. Courtenay (L. & N. R.R.) and I. L. Simmons (Rock Island) referred to methods of strengthening existing structures so as to increase their life. Truss spans can be reinforced at weak points and falsework may be placed to reduce length of viaduct spans. The Louisville & Nashville has done some interesting work in converting old steel viaducts into reinforced-concrete structures of greater strength. Along the same line P. B. Motley referred to the use of reinforced-concrete trestles on the Canadian Pacific Ry. to replace timber trestles which require removal, but for which the cost of steel structures is prohibitive. B. R. Leffler (New York Central Lines) suggested the possibilities of doubling up the girders in old spans.

Overhead construction for electric transmission lines, as provided in the proposed national electric safety code, does not come up to the standards used and considered necessary by railway companies for the protection of their roads where crossed by transmission lines. The U. S. Bureau of Standards has suggested a compromise in the general specifications. The railways contend, however, that while they have no desire to enforce their standards for use by power companies in general, they do desire to enforce them at the crossings. These aspects of the situation were brought out in a discussion between members of the committee on electricity and Dr. Lloyd of the Bureau of Standards.

Is a Track Sign a Signal?

Relations between train signals and track signs were the subject of brisk discussion. The signal committee considered that certain track signs are in effect signals covered by the standard code of the American Railway Association, and therefore for these fixed signs it submitted designs conforming to signal indications. W. C. Cushing (Pennsylvania lines) objected to this, stating that fixed signs should be of a type distinct from the movable signals which govern trains.

It was suggested further that for signs which must be visible at night it is necessary to have color instead of shape, and for this purpose to use lamps with the same colors as those of the signals. On the other hand, it was shown that for the important signs indicating "reduce speed" and "resume speed" the New York Central uses a sign which is conspicuous by day and illuminated at night, its meaning being then given by perforated lettering. The committee suggested that the matter be referred back to it for consideration, but when the vote was taken the committee's original report was adopted.

Hitherto it has been the practice to approve formally and somewhat perfunctorily the specifications submitted by the signal committee with the recommendations of the Railway Signal Association. It was suggested that such recommendations should be submitted first to committees interested in the subjects, and it was decided that in future this will be done.

Election of officers resulted as follows: President, C. A. Morse, chief engineer of the Chicago, Rock Island & Pacific Ry.; vice presidents, Earl Stimson, Baltimore & Ohio R.R., and H. R. Safford, Grand Trunk Ry.; treasurer, George H. Bremmer; secretary, E. H. Fritch, Chicago; directors, J. L. Campbell, El Paso Southwestern, E. A. Frink, Seaboard Air Line, and E. H. Lee, Chicago & Western Indiana; members of nominating committee, J. E. Crawford, Norfolk & Western, H. T. Douglas, Jr., Chicago & Alton, J. V. Hanna, Kansas City Terminal, J. B. Jenkins, Baltimore & Ohio, and J. E. Willoughby, Atlantic Coast Line.

Officers in Old Cantonment Division Promoted

Ten Are Made Colonels and Eighteen Lieutenant Colonels—Men Below Move Up

(Washington Correspondence)

Following the announcement that the Cantonment Division of the Quartermaster Corps would hereafter be known as the Construction Division and would report direct to the Chief of Staff of the Army, a number of the officers in that division have been promoted. These promotions are particularly noteworthy because they elevate to the rank of colonel a number of engineers from civil life who have been at the head of various branches of the cantonment and other army construction during the past months of war. Colonels from civil life have been very rare, so the officers just raised to that rank are especially honored.

At the head of the list of colonels is Richard C. Marshall, Jr., U. S. A. Colonel Marshall is the regular army officer who has just been put in charge of the division. His promotion is to the grade of colonel in the National Army, as are all the others. Following Colonel Marshall in order of their ranking are Frank M. Gunby, Milton J. Whitson, Peter Junkersfeld, Evan Shelby and Joseph N. Willcutt. All of these have been in the Cantonment Division since the beginning of the war and have risen to their present rank by regular promotion from their initial rank of major. Colonel Gunby is in charge of engineering, Colonels Whitson and Junkersfeld in charge of construction and field operations, Colonel Shelby is the head of the legal department and Colonel Willcutt of the materials department.

Four majors in the division were also made colonels. They are Joseph H. Alexander, who has charge of the administration end of the division, William A. Starrett, who is in charge of contracts, Millard A. Butler, the constructing quartermaster at Port Newark, and Millard A. Butler, the constructing quartermaster at Newport News.

Eighteen officers were made lieutenant colonels, Quartermaster Corps, National Army. All were majors, some in the engineers, some in the quartermaster corps, except C. D. Hartman, who was a captain, Q. M. C. The men promoted were: Philander Betts, Lincoln Bush, O. F. Chamberlain, William M. Couper, Harry S. Durant, C. D. Hartman, Walter L. Henwood, Dabney H. Maury, E. B. Morden, J. N. Pease, Warren R. Roberts, Donald H. Sawyer, E. C. Stockdale, G. F. D. Trask, George B. Walbridge, Francis B. Wheaton, R. M. White and Clark C. Wright.

In addition 30 captains were made majors and 17 first lieutenants and 11 second lieutenants were made captains. These men came from both the engineer and quartermaster corps but are promoted in all cases to the quartermaster corps, National Army.

It is understood that the change of name of the division will not involve any change whatsoever in its duties. It will still have charge of all construction for the army inside the territorial boundaries of the United States as well as such maintenance and repair as came within the jurisdiction of the Cantonment Division.

Free Ports Authorized by Bills Before Congress

Two bills, one introduced in the House by Representative Sanders and one in the Senate by Senator Sheppard, provide for the establishment, operation and maintenance of free ports in the United States, or, more specifically, free zones in ports of the United States. These free zones are to be inclosed and guarded areas in which the ordinary customs laws of the country are inoperative; that is, raw materials normally taxed in importation can be brought into these ports and there manufactured into goods which can be exported without payment of the customary duty. Such ports do not exist in the United States at the present time.

The new bills provide that the Secretary of Commerce can grant to public or private corporations the privilege of establishing, operating and maintaining such zones for such periods as the Secretary may determine, not exceeding 50 years. Not more than one free zone shall be authorized in any port of entry. The bills further provide the applications to be made for the establishment of such ports and permit the Secretary to lay down the rules and regulations governing their administration.

A considerable agitation for the establishment of a free port at New York City has been under way for some months, and may be responsible for the two bills which have been introduced, and which now are in committee.

Hugh L. Cooper Takes Charge of Muscle Shoals Dam

Lieut.-Col. Hugh L. Cooper, U. S. Engineer Officers' Reserve Corps, has returned from work with the expeditionary forces in France to take charge of the construction of dam No. 2 at Muscle Shoals on the Tennessee River, provision for the construction of which was announced in *Engineering News-Record* of Mar. 7, 1918. Colonel Cooper has been in France for a number of months, mainly working on the port and terminal work there. His great experience in large dam construction, particularly his experience on the McCall ferry dam on the Susquehanna and the Keokuk dam on the Mississippi, makes him particularly fit to take over the construction of the new Tennessee River dam. His headquarters will be at Sheffield, Ala.

Largest Naval Bill Has Big Construction Program

New Dry Dock at Charleston, S. C., Provided and New Railway Down Potomac Valley Subsidized

The naval appropriation bill reported to the House of Representatives Mar. 19 contains the largest appropriation in history for that branch of the Government. Including such deficiency appropriations as are taken care of in other bills, the total amount of naval appropriations for the naval establishment for the fiscal year ending June 30, 1918, if this bill is enacted, will be $1,659,209,531.45. In this amount will be included large sums for construction work under the direction of the Bureau of Yards and Docks.

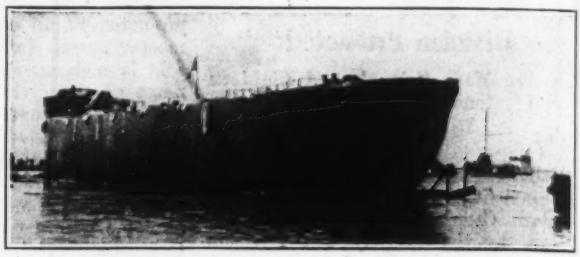
Some of the principal items under this head are: To complete dry dock at Philadelphia, $2,000,000; to complete Norfolk dry dock, $2,000,000; buildings and grounds at the Naval Academy, $2,275,000; naval operating base at Hampton Roads, $2,500,000; Marine Corps base at San Diego, $1,500,000; purchase of land for the enlargement of the Washington Navy Yard, $488,000. The total appropriation for public works amounts to $25,226,875.

An additional dry dock on the Atlantic coast somewhere south of Hatteras was considered necessary by the Navy Department, and in pursuance to its recommendation the bill contains an appropriation of $1,000,000 for the dredging of a proper channel at Charleston, S. C., the limit of cost of which is set at $5,000,000 and $1,150,000 for a large dry dock there to cost not more than $5,000,000.

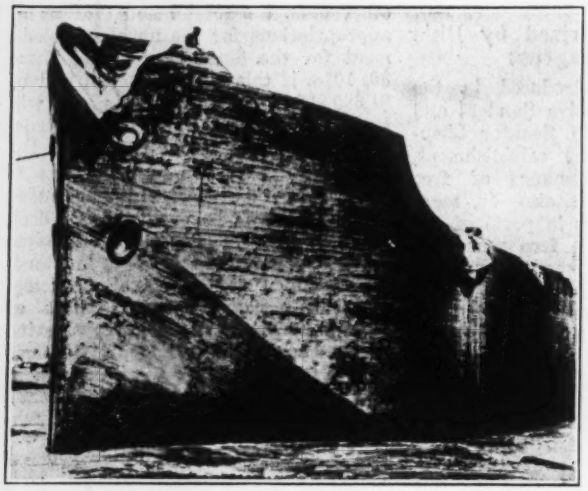
Another section of the bill authorizes the Secretary of the Navy to advance money to any company proposing to build a railway from the District of Columbia to Indian Head, Maryland, the naval proving ground on the east shore of the Potomac, some forty miles below Washington. The wording of the bill is as follows: "The Secretary of the Navy is authorized . . . to enter into a contract with some railroad company proposing to uild a line of railway from a point in r in the vicinity of the District of Columbia to Indian Head, Md., to advance to said company a sum not to exceed $360,000 . . . and to accept for said amount transportation warrants of such railroad company for a like amount to be redeemed by charges for transportation of freight for the Navy." A railway entitled the Washington-Newport News Shortline will, it is understood, be selected under this provision. This road was projected some time ago but has been delayed by the current high prices and slow deliveries. It is figured that the new line will make time of travel about four hours from Washington to Hampton Roads district, which is about half the time required by the present roundabout railway routes or by the steamship line down the Potomac.

The Five-Thousand-Ton Concrete Freighter "Faith"

Launched recently on the Pacific Coast with complete success, she is the first concrete vessel comparable in size with the modern steel freighter. She took the water about six weeks after the first concrete was poured.

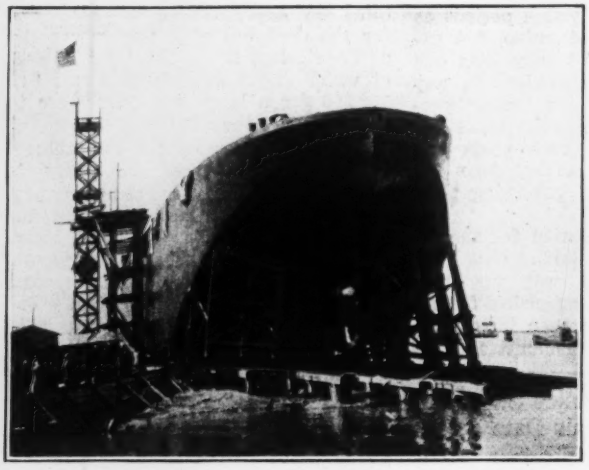


HULL DID NOT SHOW A SINGLE CRACK

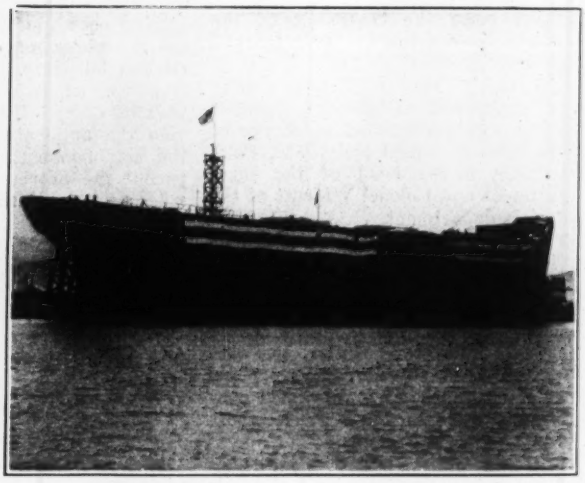


THE HULL DREW SLIGHTLY LESS THAN NINE FEET

WIDE DECK GIVES IDEA OF VESSEL'S SIZE



ENTIRE CONSTRUCTION PLANT SHOWS AT LEFT



THE LAUNCH WAS MADE SIDEWISE

Hearing on New York Contractors' Bill Today

A joint committee of the New York State legislature expects to hold today hearings on the bill referred to it by both houses authorizing state, municipal and county authorities to cancel construction contracts and have the work completed by the original contractors at actual cost reckoned since the date when this country entered the war. As noted two weeks ago in *Engineering News-Record*, this situation became so serious for the contractors that the completion of important work, including the New York State barge canal and the New York City dual subway system, was threatened unless some steps were taken to assist the contractors.

It is understood that there is no opposition on the part of the Public Service Commission to the principle involved in the suggested settlement; the Board of Estimate of New York City, which pays for the subway construction, is not publicly on record as having taken any action with reference to the bill; the authorities concerned with the state barge canal construction are said to approve it; and the contractors, who are understood to have taken the lead in having the bill introduced, are hopeful of its passage at the present session of the legislature.

Joint Committee Designs Concrete Barge of 2000 Tons

The joint committee on concrete ships and barges of the American Concrete Institute and the Portland Cement Assn. some months ago prepared a report on the whole subject of reinforced-concrete ships. It included a detail design of a 2000-ton reinforced-concrete barge. The committee has issued a supplemental design of a smaller barge, prepared by Robert W. Boyd, consulting engineer, New York. This barge is 465 tons dead weight and 8½ ft. draft. It is 112 ft. over all in length and has 33-ft. beam. Suggested specifications, together with the detail design of the barge, may be obtained by writing to the Portland Cement Assn., 111 West Washington St., Chicago.

Canadian Government Provides for Railway Maintenance and Equipment

The Canadian Government has made extensive appropriations for railway maintenance and equipment. The sum of $7,500,000 will be loaned to the Grand Trunk Pacific Ry. to pay interest on bonds, to meet deficits and pay for betterments and equipments. The amount is to be payable on demand and to be secured by mortgage. Negotiations looking to the nationalization of the Grand Trunk will, it is understood, be continued when Premier Borden and several of his colleagues go to England in June.

The sum of $25,000,000 is appropriated as a loan to the Canadian Northern Ry., which is practically a Government road, the Government having acquired the whole of the common stock, though the company is continued as a corporate entity. The money will be used to pay interest on debentures and maturing loans and to meet the cost of construction, improvements and equipment.

Orders for equipment for Canadian Government railroads aggregating about $22,500,000 have been placed.

Rensselaer Advances Graduation

It has been decided to graduate the senior class of Rensselaer Polytechnic Institute this year six weeks earlier than usual. Commencement will be held about May 1, at a date not yet determined. The work of the junior class will be continued through the summer and this class will be graduated as soon after the first of January, 1919, as may be practicable.

The board of trustees of the Institute has also offered to give instruction to about 400 conscripted men from the cantonments, should it be decided to send these men for summer schools to be established at Rensselaer in various branches of engineering and vocational work; this introduction is to be given under certain conditions to be arranged between the Federal Board for Vocational Education and the trustees of the Institute. About 80 more men have left the Institute this year for the war and work in allied industries. About 500 graduates and students of the Institute are now wearing service uniforms either in the Army or the Navy.

Engineering Foundation Election

The annual meeting of the Engineering Foundation was held in New York Mar. 21. The following officers were elected for 1918: Chairman, Michael I. Pupin (reëlected); vice chairmen (two), Edward Dean Adams and (new) W. F. M. Goss; secretary (reëlected), Alfred D. Flinn; treasurer (reëlected), Joseph Struthers.

Business Men Favor Legislation Developing Water Power

Results of a questionnaire sent out by the United States Chamber of Commerce (noted in *Engineering News-Record* of Feb. 14, p. 330) indicate that the members of the chamber, comprising about 500,000 business men, are in favor of immediate Federal development of the water power of the country. The various questions and their answers show that the trend of opinion favors an administrative department control, a permit of at least 50 years, receptive only on payment of a fair return and state control as to issuance of securities.

Liberty Loan Insert

Bound with this issue of *Engineering News-Record* will be found a Liberty Loan poster by Victor Perard, designer of the poster, "Is This My Boy?" issued last fall by the McGraw-Hill Co., Inc. To help the publicity being arranged for the third Liberty Loan, which the poster indicates will pull the Kaiser from his pedestal, small stickers of the poster will be attached to all first-class mail of this company during the month of April. The stickers will be supplied at cost to any firm desiring to use them.

Calendar

Annual Meetings

AMERICAN WATER-WORKS ASSOCIATION; 47 State St., Troy, N. Y.; May 13-18, St. Louis, Mo.

AMERICAN ASSOCIATION OF ENGINEERS; 29 South La Salle St., Chicago; May 14, Chicago.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS; 29 West 39th St., New York; Spring meeting, June 4-7, Worcester, Mass.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS; 129 York St., Brooklyn, N. Y.; June 19-22, Berlin, N. H.

AMERICAN CONCRETE INSTITUTE; 27 School St., Boston; June 24-26, Atlantic City, N. J.

AMERICAN SOCIETY FOR TESTING MATERIALS; University of Pennsylvania, Philadelphia; June 25-28, Atlantic City, N. J.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS; 29 West 39th St., New York; Atlantic City, June 26-28.

ENGINEERING SOCIETIES

Through a typographical error, the date and place of the 1918 convention of **The American Water-works Association** were again printed incorrectly in last week's *Engineering News-Record*. The correct place and date are St. Louis, May 13-18.

The feature of the annual meeting of **The Boston Society of Civil Engineers** Mar. 20 was an address by the retiring president, Prof. George C. Whipple, on "The Engineer in the New Democracy." A considerable portion of this address may be found on p. 599 of this issue. Prof. C. M. Spofford was elected president of the society for the ensuing year and the secretary-treasurer was reëlected, in accordance with the practice of the society.

A joint meeting and dinner of **The San Francisco sections of five national engineering societies** was held at San Francisco, Mar. 20, in honor of Prof. George F. Swain, past president of the American Society of Civil Engineers, professor of civil engineering in the graduate school of engineering at Harvard University and the Massachusetts Institute of Technology. Professor Swain spoke on "National Issues of Today." Brief addresses were made by Max Thelen, president of the California Railroad Commission, on "The Effect of Regulation on Fuel Conservation"; D. M. Folsom, petroleum administrator, on "The Importance of Oil Production in War Time," and P. M. Downing, of the Pacific Gas & Electric Co., on "Interconnection of California Transmission Systems." Dr. Benjamin Ide Wheeler of the University of California presided at the dinner.

At a joint meeting of **The Cincinnati Engineers' Club and the Cincinnati section of the American Society of Mechanical Engineers**, Mar. 21, the principal speaker was C. U. Carpenter, vice-president and general manager of the Recording & Computing Machines Co., of Dayton, who gave some interesting data concerning the company's experience in the use of female labor in its manufacturing operations. His subject was "Training of Women for Industry," and he stated, among other things, that of the 8300 employees in the big plants of the company at Dayton 7800 are women. He declared that with a few weeks' training women are more efficient than men in many operations, the company's experience showing that they learn the operation of machinery more rapidly than men. High wages are the rule, as compared with those ordinarily paid women, $4 a day being the average rate for a week of 51½ hours. Henry Ritter, general superintendent of the Lunken-

heimer Co., of Cincinnati, talked on "Shop Kinks," and Prof. J. T. Faig, of the University of Cincinnati School of Engineering, read a paper on "Economical Use of Coal by Communities." George W. Galbraith, of the Worthington Pump & Machinery Co., presided.

At the meeting of the **Albany Society of Civil Engineers**, Mar. 29, J. Waldo Smith, chief engineer of the Board of Water Supply of New York City, will give an illustrated talk on the new Catskill water supply of New York City. The society recently engaged in a campaign to "round up" books for the men in the military service.

The Oakland, Calif., Engineers' Club at its Mar. 13 meeting discussed "The Licensing of Engineers." Ten-minute talks were made by several members, after which there was general discussion on the subject.

At a special meeting of **The Engineers' Club of Trenton, N. J.**, Mar. 26, E. Kilburn Scott, consulting engineer, London, England, delivered an illustrated lecture on "Nitrogen from Air for Explosives."

The March meeting of **The Engineers' and Architects' Club** of Louisville was held Mar. 19. The following papers were read: "The Road Situation in Kentucky," by Hon. Rodman Wiley, State Commissioner of Roads; "The Relation of Traffic to the Type of Road," by W. F. Brooks, U. S. Senior Highway Engineer; "Selection of Type of Road to Build," by R. C. Heath, Road Engineer, Dept. of Public Roads of Kentucky (formerly with the Massachusetts Highway Commission).

The luncheon talk of **The Engineers' Club of San Francisco** on Mar. 22 was made by Jerome Landfield, on "Russian Conditions and Their Relation to America."

A meeting of **The Vancouver Branch of the Canadian Society of Civil Engineers** was held at the headquarters, Board of Trade Building, Mar. 15. An illustrated lecture was given by A. G. Dalzell, associate member, Canadian Society of Civil Engineers, on "The Problem of City Development: An Economic Survey."

On Mar. 21, under the auspices of **The Oregon Society of Engineers**, E. B. Thompson delivered an illustrated lecture before the members of the American Society of Civil Engineers, American Institute of Electrical Engineers, National Electric Light Assn., Northwestern Assn. of Highway Engineers, Oregon Society of Engineers and others, on "The Oregon City Locks."

The Nebraska Association of Members of the American Society of Civil Engineers and the Omaha Technical Club have invited all engineers and those interested in road and other internal improvements to a joint meeting at the Paxton Hotel, Omaha, Mar. 30. The matter under consideration, and believed by the societies to be of vital importance to the engineers of the state, is the November referendum to decide whether a constitutional convention should be called to prepare a new constitution for the state. It is believed that the constitution should be changed so that the administration of the internal improvements of the state would be in charge of a commission or commissioner with executive power. The constitution prohibits the passage of revenue measures sufficient to carry on the work and place the burden where it belongs.

The Indiana Sanitary Engineers in convention Mar. 13 reëlected William J. Wooley, Evansville, president by a unanimous vote, J. Holland, Logansport, is secretary-treasurer. The next convention will be held in Terre Haute in 1919.

The Quincy, Ill., Engineers' Society elected W. F. Gerdes, of the Michelmann Steel Construction Co., president, Mar. 5. The other officers elected were: Vice president, E. Richmond, of the Quincy Gas, Electric and Heating Co.; secretary-treasurer, A. C. Weiner, of the Perkins Engineering Co. A committee was named by President Gerdes to visit every engineer in the city in the society membership campaign.

The Cleveland Engineering Society Mar. 26 listened to a paper on "Electric Butt Welding," by J. B. Clapper, plant engineer, rim and tube division, Standard Parts Co., Cleveland, and on Apr. 2 will be addressed on the subject of "Manufacture and Uses of Carbon Products," by V. C. Hamister, engineer, National Carbon Co., Cleveland.

The Seattle Association of Members of The American Society of Civil Engineers holds a regular meeting and luncheon on the last Monday of every month. The officers for the year 1918 are: A. S. Downey, president; L. M. Grant, vice president; Phil. A. Franklin, secretary-treasurer.

PERSONAL NOTES

DANA M. MINER, formerly assistant engineer, N. Y. Barge Canal, at Rochester, and Jacob L. Crane, Jr., former assistant state sanitary engineer of Michigan, have become associated with Gannett, Seelye & Fleming, engineers, Harrisburg, Penn., as assistant engineers in the construction of Government warehouses. Gannett, Seelye & Fleming, who handled the field engineering on the Government aviation storage depot at Middletown, Penn., have been retained in a similar capacity on the new buildings recently started as additions to this storage depot.

H. R. MANBY has been appointed chief engineer of the Tennessee Central R.R. He was formerly superintendent and engineer maintenance of way, but the position of engineer maintenance of way has been abolished.

G. R. HERINGTON has been appointed supervising engineer of the Tucson division of the Southern Pacific Ry. He has been charged with maintenance of way and supervision of structures of the division.

L. A. WATERBURY, professor of civil and architectural engineering, University of Arizona, has been granted leave of absence for the remainder of the present semester, to accept a position on Government work under M. S. Ketchum.

RAY T. SMITH, until recently superintendent of construction for the Consumers' Power Co., Bamfield Dam, Mich., has accepted a similar position with the St. Lawrence Transmission Co., Colton, N. Y.

C. E. BARGLEBAUGH, member of the firm of Lang & Witchell, architects and engineers, El Paso and Dallas, Tex., is temporarily with the department of concrete ship construction, U. S. Shipping Board, Washington.

JAMES A. TRAVILLA, former director of streets and sewers of St. Louis, has gone to Washington to take an appointment to serve with a corps of other consulting experts on road construction and pavement work in the cantonments and other Government highway work. Mr. Travilla's special service will be as a brick expert wherever this form of paving is required. He will continue to maintain his office in St. Louis, but will be in Washington for an indefinite period.

J. E. LETSON, formerly in charge of construction work for the Canadian Northern R.R. Co., in the Lake Superior district, and recently with the New York, New Haven & Hartford R.R. Co., in the division of valuation, has been appointed assistant engineer in charge of railroad construction at the Government ordnance storage depot, Harrisburg, Penn.

MORRIS KNOWLES, consulting engineer, Pittsburgh, Penn., has been appointed chief engineer of the housing division of the United States Shipping Board, which is under the direction of J. Rogers Flannery, president of the American Vanadium Co. This division has charge of the housing design and construction under the $500,000,000 appropriation bill signed by the President a month ago. Charles M. Reppert, division engineer, Bureau of Engineering, Pittsburgh, is principal assistant engineer under Mr. Knowles and W. H. C. Ramsey, superintendent of the Johnstown Water Co., of Johnstown, Penn., is designing engineer.

L. H. NISHKIAN, for the past four years consulting structural engineer of the Board of Public Works,

San Francisco, has been granted a year's leave of absence by the board to accept a position with Macdonald & Kahn, of that city, in charge of their engineering work. Mr. Nishkian has been in the service of the city for seven years, having been connected with the city engineer's office for three years.

JOHN H. BLAIR, Colly, Ky., connected for years with The Big Sandy Co., has accepted a position as chief engineer for The Kentucky Solvay Co., with offices in Pikeville, Ky., and will enter upon his new work at once.

COL. THOMAS F. SULLIVAN, appointed Commissioner of Public Works of the City of Boston by Mayor A. J. Peters, has been roadmaster of surface lines of the Boston Elevated system, and is credited with the introduction and use of many road building and road repairing devices. Colonel Sullivan is a veteran of the Spanish-American War. He won his military title by service in the state militia and is now commander of the Tenth Regiment, Massachusetts National Guard. He retired from active service in 1914. Colonel Sullivan is forty years old and a graduate of the English High School of Boston. He is a member of the American Electric Railway Engineers' Association.

E. E. WEAVER, city engineer of Independence, Kan., has resigned to enter the service of the Central States Oil Company.

GEORGE YEOKUM has been employed as a special assistant engineer by the Kansas State Board of Health to study the salt and oil wastes in the streams of southern Kansas and their effects upon the water supplies of towns along those streams.

CHARLES W. HARDT, Harrisburg, Penn., connected with the State Highway Department for the past 12 years, and now in charge of the Dauphin, Lebanon, Perry, Juniata and Snyder Counties state highways, has received a leave of absence from State Highway Commissioner O'Neil to engage in Government work. Mr. Hardt will be first assistant engineer to Maj. W. B. Gray in charge of construction of depots along the Susquehanna River.

ARTHUR C. BRANDT, until recently with Mowbray & Uffinger, architects, Springfield, Mass., is now with Fred. T. Ley & Co., Inc., at Perryville, Md.

CARROL D. HALE, recently with J. J. O'Heron & Co., Chicago, received a first lieutenant's commission at Fort Monroe, in the Coast Artillery. He is now at the army heavy artillery school, American Expeditionary Force, in France.

WILLIAM HANNA, port engineer of the Pacific Steamship Co. at San Francisco, is to go to France as a supervising engineer for one of the ports at which troops and supplies for the American expeditionary force are landed. He has been commissioned a captain in the Army and instructed to prepare himself within six months for examination for a major's commission.

ERNEST R. RHINE has resigned his position with the Interstate Commerce Commission, division of valuation, to accept a position as engineer for the Oakland Paving Co., Oakland, Calif.

A. D. ALEXANDER has purchased the Pittsburgh office of the Richard D. Kimball Co., consulting engineers, specializing in building equipment, and will continue the business under his own name. He has been resident engineer in charge of the office for the past three years, and was formerly engineer with the Pittsburgh Board of Public Education.

JAMES A. BAILEY, JR., Arlington, Mass., has been appointed a member of the Metropolitan Water and Sewerage Board in place of Thomas E. Dwyer, whose term has expired. Mr. Bailey was chairman of the Metropolitan Sewerage Commission when it was consolidated with the Metropolitan Water Board some years ago. He then became a member of the consolidated board and held that office until a political change occurred in the state administration.

H. G. ROBY has resigned the position of city manager of Alpena, Mich., to accept a commission as civil engineer, U. S. Naval Reserve Force, with the rank of senior lieutenant. He is stationed at Washington and is in charge of the inspection of materials and construction in the erection of two large reinforced-concrete buildings.

J. W. BARTHOLOW, recently assistant engineer, Atchison, Topeka & Santa Fe Ry., Topeka, Kan., has been made office engineer of the Missouri, Kansas & Texas Lines, Dallas, Tex.

GULICK-HENDERSON CO., INC., inspecting engineers, announce the removal of their New York offices to the Herald Square Building, 141-145 West 36th Street.

STEPHAN J. HAUSER, chief chemist and bacteriologist of the Cincinnati water-works filtration plant, has accepted a position as superintendent of filtration for the city of Youngstown, Ohio. Clarence Bahlman, chemist for the board of health of the City of Cincinnati, has accepted the position made vacant by the resignation of Mr. Hauser.

JOHN C. DIGGS, sanitary engineer, Indiana State Board of Health, has been commissioned first lieutenant in the sanitary corps of the Army medical department.

H. G. MCGEE, assistant engineer, sanitary engineering department, Lucas County, Ohio (Toledo), has been commissioned first lieutenant in the sanitary corps of the Army medical department. He is at the medical officers' training camp at Camp Greenleaf, Georgia.

JOHN G. REINKE, designing engineer with the division of sewerage, city of Cincinnati, has resigned to accept a position in the engineering department of the National Cash Register Co., Dayton, Ohio.

A. F. MAISH, an assistant engineer in the engineering department of the city of Cincinnati, has resigned to accept a position as mechanical draftsman with the Navy Department at Washington.

OBITUARY

SIR COLLINGWOOD SCHREIBER, general consulting engineer to the Canadian Government, died at Ottawa, Mar. 23, at the age of 87. Sir Collingwood went to Canada from England in 1852 as assistant engineer of the Hamilton & Ontario Ry. He had been engineer on many enterprises, and from 1872 to 1878 was chief engineer and general manager of the Canadian Government Railways. He was chief engineer and deputy minister of railways and canals in the Dominion of Canada from 1892 to 1905, when he accepted the post he held at the time of his death. Sir Collingwood was knighted in 1893.

CASSIUS W. KERRICK, a pioneer railroad construction contractor of the West, died Mar. 13 at Pasadena, at the age of seventy-one. He was formerly chief engineer of the Great Northern Railroad and Northern Pacific lines and was actively engaged with James J. Hill and others in the development of the Northwest.

SAMUEL N. LEE, of Kansas City, formerly an engineer and contractor on railroad construction, died Mar. 21, at the age of 63. He was one of the builders of the Kansas City-St. Louis line of the Rock Island R.R. and of the Kansas City Southern road.

HENRY CLAY PERKINS, former city and county engineer of Leavenworth, Kan., died Mar. 16, at the home of his son Harry Perkins, who is now city engineer of Leavenworth. H. C. Perkins was a veteran of the Civil War and went West in the railway service in 1876. He was 85 years old.

HARRY JACOB, formerly a prominent engineer of Louisville, Ky., who for the past few years has been city engineer of Oklahoma City, Okla., was killed Mar. 20, at Oklahoma City, when a sand embankment gave way, burying him under tons of sand.

NEWS OF ENGINEERING INDUSTRIES

FOR MANUFACTURERS WHO SERVE ENGINEERS AND CONTRACTORS

Steel, Cement and Lumber Sufficient for War and Local Needs

Representatives of Industries Take Optimistic View of 1918 Outlook in Addressing Western Engineers

Will the supply of structural materials—particularly steel—be adequate to meet the demands of war and the necessary industrial expansion this year? Has curtailment of building construction caused such a slump in cement and lumber output that stocks will not be sufficient to meet an active demand for building materials?

These questions have occurred to many engineers and construction men. They were answered in considerable interesting detail at a meeting of the Western Society of Engineers in Chicago last week by F. J. Llewellyn, of the American Bridge Co., B. F. Affleck, president of the Portland Cement Association, and Dr. Herman Von Schrenck, consulting engineer of the National Lumber Manufacturers Association.

"The ingot capacity of the United States for 1918 seems to be rather definitely fixed at 50,000,000 tons," said Mr. Llewellyn, "and that of the remainder of the world at another 50,000,000 tons, a total of 100,000,000. Of this total capacity 16,000,000 has been added since the war broke out, 10,000,000 being credited to the United States and 6,000,000 to the other steel producing countries.

"But the word 'capacity' must, under existing circumstances, by no means be taken as synonymous with "production,' which latter is rendered indefinite by and largely dependent upon weather conditions, the car situation and the labor market. As to the first named — the weather conditions — it would probably not be an exaggeration to say that the year 1918 has already been deprived of one full month of production resulting from the storms of January and February, and possibly 10% of the year's capacity has thus already been lost. Conditions now are greatly improved and many of the mills are rapidly approaching their capacity output.

Heavy Car Shortage

"As to the car situation, clearly it is one of tremendous difficulty. I suppose that the railroads are at this moment short of filling the orders which they have actually received for loading not less than 160,000 cars, while there is probably material finished and waiting to be loaded sufficient to fill another 160,000 cars, on which orders are simply being held until the prospect of filling them improves. This would mean a total shortage of 320,000 cars.

"Of the labor situation it may be said that it has been surprisingly satisfactory; and so far as I am in touch with the facts, I should say that there has been no widespread or greatly serious shortage. The references to this subject in the public journals have perhaps been based upon anticipated requirements.

"As of some related interest, it may be noted that the structural shops here in the West are running certainly at not more than 75% of their capacity, with individual cases at a less rate.

Surplus of Steel Capacity

"Addressing ourselves, then, to the definite questions involved, I give it as my opinion for whatever this may be worth, that 50,000,000 tons of steel is more than can be used or will be required in this country along emergency priority lines, and that if 50,000,000 tons of steel is actually produced it will mean a considerable surplus applicable to normal construction requirements.

"Upon the subject of shop space we can speak more definitely; and I venture to say that the fabricators here in the West could without difficulty take on and execute during 1918 100,000 to 150,000 tons of building and bridge construction, provided the same were available; and that, too, without interfering with the emergency calls that have been made and are likely to be made upon them."

Plenty of Cement

B. F. Affleck pointed out how car shortage had affected the cement output. He discussed highway and water transportation, and pledged the support of the cement industry to all the demands of the Government and its railways. "The cement plants of the United States have a capacity for the production of about 120,000,000 barrels of portland cement annually," said Mr. Affleck. "The maximum year's consumption (1916) was 94,552,296 barrels. Under ordinary conditions all of the producing capacity can probably never be employed in any one year, because at no time is it likely that normal conditions as affecting production, labor and use of cement will prevail throughout the entire country.

"From the foregoing statement it will readily be seen that the engineer will have no difficulty in obtaining all of the portland cement he may need, provided cement makers are able to obtain material, labor, fuel, transportation and the numerous other smaller but none the less essential supplies.

"Production and shipments at most plants are much below normal, the statistics showing shipments from all plants in the United States for January and February have been 31 per cent. less this year than last.

What Is Holding Back Building?

"Production is curtailed because of inability to obtain material, fuel and labor, and shipments are curtailed by reason of inability to obtain cars. There is apparently a desire on the part of cement users to use a normal quantity of cement, but this desire does not materialize into actual demand for various reasons, among which the following are perhaps the most important:

"1. Government authority operating through Federal Reserve Board and the Capital Issues Committee prohibits the sale of securities in amounts in excess of $100,000 unless in the opinion of the Federal Reserve Board the purpose for which the money is desired has a direct relation to winning the war.

"2. The high cost of building, due to high cost of labor and materials.

"3. The long time consumed in building, due to shortage of labor and materials, irregularities in transportation, etc.

"4. Unfavorable attitude of banks toward any financing for other than liquid transactions.

"I give it as my judgment that most of our troubles are traceable to inadequacy of railroad facilities or, to state it more accurately, a sudden overloading of our transportation system. The railroads should not be blamed for this condition.

Need for Railways and Roads

"As far as railroad construction is concerned, I believe it goes without saying that the Government now realizes so completely the necessities of the railroads that there will be a classification which will give this particular work a place close to the head of the list.

"Two other means of transportation — highways and waterways — deserve mention. A large percentage of freight handled by rail has its initial or final movement, or both, over the highway. Practically all food and package freight belongs in this class. It seems to me the railroads should encourage in every way possible the construction of good roads. They sup-

plement rather than compete with rail transportation. It is true that trucks are now handling much freight which under normal conditions would move by rail, but this is for the most part short haul traffic which is unprofitable to the rail lines and on which they cannot, even in normal times, furnish as rapid service as the truck which can handle direct from storehouse to store door.

"As to the waterways, it is doubtful if we can afford at this time to spend much money or effort in connection with the inland, artificial waterway of shallow draft. The results would be too small and the time consumed too long. Concerning the natural deep waterways, requiring a relatively small expenditure to make them available, while laws were passed divorcing steamship lines from railroad ownership or control, it is to be hoped that under Government conditions such arrangements will be resumed as will enable the railroads to use steamboat connections to the best possible advantage.

"In conclusion let me repeat, the cement industry stands ready to meet any demands the railroads or the Government may make of it, subject only to its ability to obtain coal, material, supplies, transportation and labor."

LUMBER STOCKS INCREASED

A clear outline of the lumber situation was given by Dr. Herman Von Schrenck, who said in part: "While a more optimistic report on labor in the lumber industry can be given now than on Mar. 1, the outlook is not nearly so favorable as that noted by Mr. Llewellyn. The main difficulties are cars, labor and priorities. The recent action of the Shipping Board in reducing the amounts of large size timbers has relieved the situation greatly. There has never been any restriction in the southern field for pine timbers under 12 x 12 in. but the west coast restrictions were much more severe where release had to be obtained for anything with one 12-in. face. Ample stocks have now been built up of the smaller sizes due to the curtailment of building operations. There should be no difficulty in furnishing lumber in ample quantities for both Government and domestic needs.

"One lesson the country is learning is that of conservation. Designers have an added impetus now to be more careful of material and to develop designs to fit the product. Laminated members are used much more frequently than formerly."

Cast Iron Pipe Shipped to China

The United States Cast Iron Pipe & Foundry Co., of Addyston, Ohio, is shipping the first of a lot of pipe which is to be made for the Chinese Government for use in the construction of a water line across the desert portion of Manchuria. Five carloads have been forwarded by way of Seattle to Shanghai, whence the material will move into the interior.

One Truck Serves Three Trailers

By using three 5-ton trailers hauled with a single 3½-ton truck, the Williams Slate Co., Granville, N. Y., has replaced two 5-ton trucks and four 2-horse teams on a short haul of 1¾ miles. The truck and trailers operate 16 hours daily in 8-hour shifts. The trips total about 60 miles a day, and an average of 4 miles to the gallon of gasoline is attained.

There is little delay to the motive power on this job at any time. While one trailer is being loaded at the quarry another is usually on the road and the third trailer is unloading at the freight yard. There is ¼ mile of 8% gradient on the road, which is in fair condition. Six-ton loads of slate are carried on the trailers, which are platform-body No. 512 Troy, of 5-ton rated capacity. The truck is a 3½-ton Mack, type AC. To date the equipment is said to have made 18,000 miles without any replacements.

Railway Appliances Make Good Exhibit at Chicago

Track materials, tools, railway signals and the like made a good display in the exhibition held at the Coliseum, Chicago, by the National Railway Appliances Association in connection with the railway engineering convention, Mar. 18 to 21. The exhibit was fully up to the standard of previous years and by a compact arrangement of the space all the exhibits were included on the main floor, although the number of exhibitors was larger than usual. One noticeable feature was the absence of large machinery. With the present demand for machines of all kinds they cannot well be spared to stand idle for exhibition purposes, and there would be difficulty and cost of transportation. Therefore models, photographs, drawings and trade literature represented such matters as locomotive cranes and spreader cars. Nor was there the usual large area of floor space devoted to rails and switches.

In track appliances, besides the usual varied lines of rail joints, rerailers, rail anchors, tie-plates, etc., there were two designs of crossing frogs giving continuous rails for one or the other track, and a new frogless turnout in which a shifting rail takes the place of a frog. A gas-heating system to prevent the collection of snow and ice at switches was one of the specialties. Substitutes for wood ties were represented by a built-up steel substructure, as used mainly for track crossings and street-railway track, and a metal tie composed of two steel castings connected by a tie bar. Something new in track fastenings was a spike made of a piece of round iron with one end bent into a loop to form the head. The spikes are driven under the rail at an angle of about 45 deg., with the end of the loop resting on the rail base.

Labor-saving devices for track work were rather less numerous than might have been expected in view of present labor conditions and the opportunity afforded of bringing these devices to the attention of railway men. Few of those were new. There were motor section cars in plenty, a rail-laying crane, portable saw for framing timbers, a pneumatic track-tamping outfit, and pneumatic spike hammers, screw-spike drivers and rail drills. A light 1-ton tractor which may be adapted to such work as ditching or clearing snow from yards was among the exhibits, and there were other tractors for freighthouse and factory use. Signal exhibits were not so extensive as usual. They included "winking" or flashlight signals and a number of visual and audible warnings for the protection of grade crossings.

BUSINESS NOTES

The sixteenth annual meeting of the National Lumber Manufacturers Assn. will be held in Chicago Apr. 9-10, at the Congress Hotel.

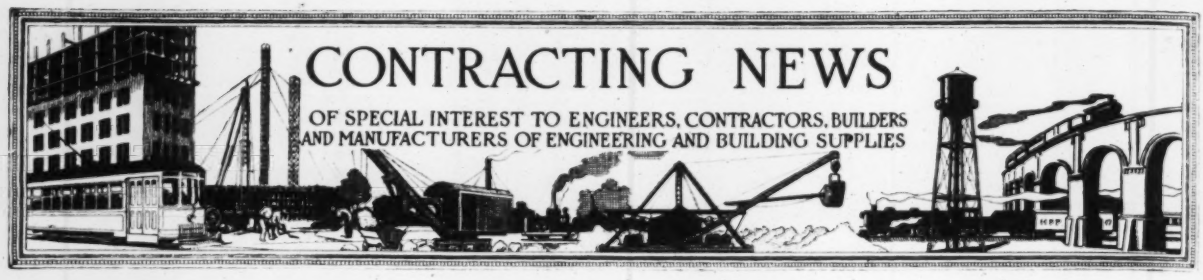
The twenty-second annual meeting of the National Fire Protection Assn. will be held in Chicago on May 7-8. The sessions will probably take place in the auditorium of the Insurance Exchange, 175 W. Jackson Boulevard.

The Detroit Steel Products Co. recently opened a new branch of its Buffalo office at 314 Onondaga County Savings Bank Building, Syracuse. The office is in charge of A. E. Swager.

At the first election of the Cincinnati Builders' Exchange under the new constitution, Mar. 13, the following officers were chosen: president, Oscar Euphrat; first vice president, J. N. Dugan; second vice president, William Langhorst; secretary, H. B. B. Yergason; treasurer, David G. Devore; executive board, Edward Brockman, William R. Barr, William M. Miller, W. T. McGarvey, W. J. Pugh, Ernest Wrampelmeier, Robert P. Harkness, William Mitchell and D. H. Startsman.

William T. Price, formerly manager and chief engineer of the oil engine department, De La Vergne Machine Co., has become president of the P-R Engine Co. of New York, and second vice-president of the Rathbun-Jones Engineering Co., of Toledo, which will undertake the sale and manufacture respectively of Price-Rathbun stationary and marine oil engines. The P-R Engine Co. has its main office at 100 W. 40th St., New York, and other offices in Philadelphia, Baltimore and Toledo.

The Easton Car & Construction Co., Easton, Penn., announces the opening of a new branch office in Washington, D. C., at 225 Kellogg Building, 1422 F Street, N. W.


CONTRACTING NEWS
OF SPECIAL INTEREST TO ENGINEERS, CONTRACTORS, BUILDERS
AND MANUFACTURERS OF ENGINEERING AND BUILDING SUPPLIES

Proposals

For Proposals Advertised See Pages 47—52 Inclusive

WATER-WORKS

Bids Close		See Eng. News-Record
Mar. 31	Pratt, Kan.	Mar. 21
Apr. 1	Barron, Wis.	Mar. 28
Apr. 1	Springfield, Ill.	Mar. 28
Apr. 3	Fall City, Neb.	Mar. 28
Apr. 3	Pittsburgh, Pa.	Mar. 28
Apr. 3	Norristown, Pa.	Mar. 28
Apr. 4	New York, N. Y.	Mar. 28
Apr. 4	Akron, O.	Mar. 28
Apr. 8	Chicago Heights, Ill.	Mar. 28
Apr. 8	Carthage, S. D.	Mar. 28
Apr. 8	Akron, O.	Mar. 28
Apr. 11	Akron, O. Adv. Mar. 28.	Mar. 28
Apr. 15	Amherstburg, Ont.	Mar. 28
Apr. 15	Jamestown, N. Y. Adv. Mar. 28.	Mar. 28
Apr. 18	Twin Falls, Idaho Adv. Mar. 28.	Mar. 28
Apr. 22	Euclid, O.	Mar. 28

SEWERS

Apr. 1	Salina, Kan.	Mar. 21
Apr. 1	Antioch, Ill.	Mar. 28
Apr. 2	Toledo, O.	Mar. 14
Apr. 2	Jersey City, N. J.	Mar. 28
Apr. 2	Hartford, Conn. Adv. Mar. 28.	Mar. 28
Apr. 5	Mansfield, O.	Mar. 28
Apr. 8	Riverbark, Cal.	Mar. 28
Apr. 9	Perrysburg, O.	Mar. 28
Apr. 15	Marion, Ia. Adv. Mar. 28.	Mar. 28

BRIDGES

Apr. 1	Newton, N. J. Adv. Mar. 28.	Mar. 28
Apr. 1	Franklin, W. Va.	Mar. 21
Apr. 1	Salina, Kan.	Mar. 21
Apr. 1	Connersville, Ind.	Mar. 21
Apr. 2	Kansas City, Cal.	Mar. 21
Apr. 2	Watertown, S. D.	Mar. 21
Apr. 2	Greenfield, Ind.	Mar. 21
Apr. 2	Brookings, S. D.	Mar. 21
Apr. 2	Gregory, S. D.	Feb. 21
Apr. 2	Spencer, Ind.	Mar. 28
Apr. 2	Hartford, Conn.	Mar. 28
Apr. 4	Williamson, W. Va.	Mar. 14
Apr. 4	Monroe, La.	Mar. 21
Apr. 5	Ft. Wayne, Ind.	Mar. 21
Apr. 5	Trenton, N. J. Adv. Mar. 28.	Mar. 28
Apr. 6	Shreveport, La.	Mar. 14
Apr. 6	Dallas, Ore.	Mar. 28
Apr. 8	Medicine Lodge, Kan.	Mar. 28
Apr. 8	Forrest City, Ark. Adv. Mar. 28.	Mar. 28
Apr. 9	Columbus, O.	Mar. 14
Apr. 9	Northbend, Wash.	Mar. 21
Apr. 10	New Martinsville, W. Va.	Mar. 21
Apr. 13	St. Albans, Wis.	Mar. 21
Apr. 13	Mifflintown, Pa.	Mar. 21
Apr. 15	Marion, Ia.	Mar. 28
Apr. 16	Sisseton, S. D.	Mar. 21
Apr. 17	Clarksburg, W. Va.	Mar. 28
May 1.	Vallejo, Cal.	Feb. 7
May 6	Belva, W. Va.	Mar. 28

STREETS AND ROADS

Mar. 29.	Tazewell, Tenn.	Mar. 14
Mar. 30	Davenport, Ia.	Mar. 21
Mar. 30	Greencastle, Ind.	Mar. 28

Bids Close		See Eng. News-Record
Apr. 1	Oswego, Kan.	Mar. 28
Apr. 1	Houston, Tex.	Mar. 28
Apr. 1.	Morgantown, W. Va.	Mar. 7
Apr. 1.	Indiana	Mar. 14
Apr. 1.	Vermillion, S. D.	Mar. 14
Apr. 1	California	Mar. 21
Apr. 1	Drumright, Okla.	Mar. 21
Apr. 1	Sonora, Cal.	Mar. 21
Apr. 1	Franklin, W. Va.	Mar. 21
Apr. 1	Dade City, Fla.	Mar. 28
Apr. 1	Chatham, Va.	Mar. 28
Apr. 1	Richmond, Va. Ad. Mar. 28.	Mar. 28
Apr. 1	Passaic, N. J.	Mar. 28
Apr. 1	Ft. Wayne, Ind.	Mar. 28
Apr. 2	Indiana	Mar. 28
Apr. 2	Salinas, Cal.	Mar. 21
Apr. 2	Eveleth, Minn.	Mar. 21
Apr. 2	Elkins, W. Va.	Mar. 21
Apr. 2	East San Diego, Cal.	Mar. 21
Apr. 2	Visalia, Cal.	Mar. 21
Apr. 2	Shelton, Wash.	Mar. 21
Apr. 2	Davenport, Ia.	Mar. 21
Apr. 2	Indiana	Mar. 21
Apr. 2.	Hickman, Ky.	Mar. 14
Apr. 2.	Indiana	Mar. 14
Apr. 2.	Richmond, Ky.	Mar. 14
Apr. 2	Newark, N. J.	Mar. 28
Apr. 2	Wichita, Kan.	Mar. 28
Apr. 2	Paterson, N. J.	Mar. 28
Apr. 3	Mt. Holly, N. J. Adv. Mar. 28.	Mar. 28
Apr. 3.	Weston, W. Va.	Mar. 14
Apr. 3	Concord, N. C.	Mar. 21
Apr. 3	Baltimore, Md.	Mar. 28
Apr. 4	Indiana	Mar. 28
Apr. 4.	Pennsylvania	Mar. 21
Apr. 4.	Michigan	Mar. 14
Apr. 4.	Defiance, O.	Mar. 14
Apr. 4	Brooklyn, N. Y.	Mar. 28
Apr. 5	Troy, O.	Mar. 28
Apr. 5	Beckley, W. Va.	Mar. 28
Apr. 5	Indiana	Mar. 28
Apr. 5	Fargo, N. D.	Mar. 28
Apr. 6	Indiana	Mar. 28
Apr. 8	Bradentown, Fla.	Mar. 21
Apr. 8	Seattle, Wash.	Mar. 21
Apr. 8	Louisville, Ky.	Mar. 28
Apr. 8	Porterville, Cal.	Mar. 28
Apr. 8	South Brownsville, Pa.	Mar. 28
Apr. 8	California	Mar. 28
Apr. 8	Little Rock, Ark. Adv. Mar. 28.	Mar. 28
Apr. 9	Buffalo, Minn.	Mar. 28
Apr. 9	Seattle, Wash.	Mar. 21
Apr. 9	Shakopee, Minn.	Mar. 28
Apr. 10	Peru, Ind.	Mar. 21
Apr. 11	Lake Alfred, Fla.	Mar. 28
Apr. 12	Centerville, Tenn.	Mar. 21
Apr. 13	St. Albans, W. Va.	Mar. 21
Apr. 15	Delaware Adv. Mar. 21 and 28.	Mar. 21
Apr. 15	Montesano, Wash.	Mar. 28
Apr. 16	Geneva, N. Y. Adv. Mar. 28.	Mar. 28
Apr. 16	Michigan Adv. Mar. 21.	Mar. 21
Apr. 16	Huntington, W. Va.	Mar. 28
Apr. 22	Seattle, Wash.	Mar. 28
Apr. 23	Valley City, N. D.	Mar. 28
Apr. 23.	Santa Domingo, West Indies	Jan. 24
May 1.	Vancouver, Wash.	Feb. 14
May 1	Brainerd, Minn.	Mar. 28
June 1	Oswego, Kan.	Mar. 28
Aug. 1	Cleveland, O.	Mar. 28

EXCAVATION AND DREDGING

Apr. 1	Maringo, Ia.	Mar. 21
Apr. 1	Adel, Ia.	Mar. 28
Apr. 5.	Ft. Dodge, Ia.	Mar. 7
Apr. 5	Blue Earth, Minn.	Mar. 28
Apr. 6	Richvale, Cal.	Mar. 28
Apr. 8	Georgetown, S. C.	Mar. 28
Apr. 9	Tracy, Cal.	Mar. 28
Apr. 9.	Oswego, N. Y. Adv. Mar. 14.	Mar. 14
Apr. 9.	Fulton, N. Y. Adv. Mar. 14.	Mar. 14
Apr. 9.	Herkimer, N. Y. Adv. Mar. 14.	Mar. 14

Bids Close		See Eng. News-Record
Apr. 10.	Huntington, Ind.	Mar. 7
Apr. 12	Burlington, Wis.	Mar. 28
Apr. 15	Madison, Wis. Adv. Mar. 21 and 28.	Mar. 21
Apr. 23	Albany, N. Y. Adv. Mar. 28.	Mar 28

INDUSTRIAL WORKS

Apr. 1.	Jersey City, N. J.	Feb. 21
Apr. 1.	Cleveland, O.	Mar. 14
Apr. 2	Portland, Ore.	Mar. 21
Apr. 4	Long Island City, N. Y.	Mar. 28
Apr. 5	Buffalo, N. Y.	Mar. 28
Apr. 10	New York, N. Y.	Mar. 28
Apr. 15	Cleveland, O.	Mar. 28

BUILDINGS

Apr. 1	Massapequa, N. Y.	Mar. 21
Apr. 1.	Albany, N. Y.	Feb. 28
Apr. 1.	Cleveland, O.	Mar. 14
Apr. 2	Oskya, Miss.	Mar. 28
Apr. 2	Houma, La.	Mar. 28
Apr. 4	Philadelphia, Pa.	Mar. 28
Apr. 8	Bloomington, Ind.	Mar. 28
Apr. 8	Groton, S. D.	Mar. 28
Apr. 8	Cincinnati, O.	Mar. 21
Apr. 8	Indianapolis, Ind. Adv. Mar. 21 and 28.	Mar. 28
Apr. 10	Keyser, W. Va.	Mar. 21
Apr. 10	Marietta, O.	Mar. 21
Apr. 10	St. Albans, W. Va.	Mar. 28
Apr. 15	Albany, N. Y.	Mar. 21
Apr. 16	Waltham, Mass.	Mar. 28
Apr. 17.	Jersey City, N. J.	Mar. 14
Apr. 18	Middleton, Mass. Adv. Mar. 28.	Mar. 28
Apr. 22	Euclid, O.	Mar. 28
June 15	Phila., Pa.	Mar. 28

FEDERAL GOVERNMENT WORK

Apr. 1.	Dredging—Baltimore, Md. Adv. Mar. 7 to 21.	Mar. 7
Apr. 1	Steel Tank—Norfolk, Va.	Mar. 21
Apr. 1	Fire Protection System—Hingham, Mass.	Mar. 21
Apr. 1	Mechanical Stokers—Phila., Penn.	Mar. 21
Apr. 3.	Levee Works—St. Louis, Mo. Adv. Mar. 14, 21 and 28.	Mar. 14
Apr. 3	Dredging and Rock Excavation—Trenton, N. J.	Mar. 28
Apr. 4	Gates and Stands—Denver, Colo.	Mar. 28
Apr. 5	Limestone and Granite—Buffalo, N. Y. Adv. Mar. 28.	Mar. 28
Apr. 5	Grading—Ft. Sill, Okla.	Mar. 28
Apr. 5.	Pipe and Fittings—Ft. Sill, Okla.	Mar. 7
Apr. 5.	Heating Plant — Phoenix, Ariz.	Mar. 14
Apr. 6.	Machinery—Pittsburgh, Pa. Adv. Mar. 14, 21 and 28.	Mar. 14
Apr. 8	Power Plant Equipment—Washington, D. C.	Mar. 28
Apr. 8.	Ditch—El Paso, Tex.	Mar. 14
Apr. 8.	Drainage—Las Cruces, N. M. Adv. Mar. 7.	Mar. 7
Apr. 9	Wharf—Washington, D. C.	Mar. 28
Apr. 10	Treasury Annex—Washington, D. C.	Mar. 28
Apr. 10.	Revetment, etc. — Nome, Alaska	Feb. 7
Apr. 10	Excavation—Boston, Mass. Adv. Mar. 21 and 28.	Mar. 21
Apr. 11	Dredging — New London, Conn. Adv. Mar. 21 and 28.	Mar. 21
Apr. 12	Removing Wreck—Washington, D. C. Adv. Mar. 28.	Mar. 28